ENGINEERING NEWS-RECORD

MARCH 21, 1946

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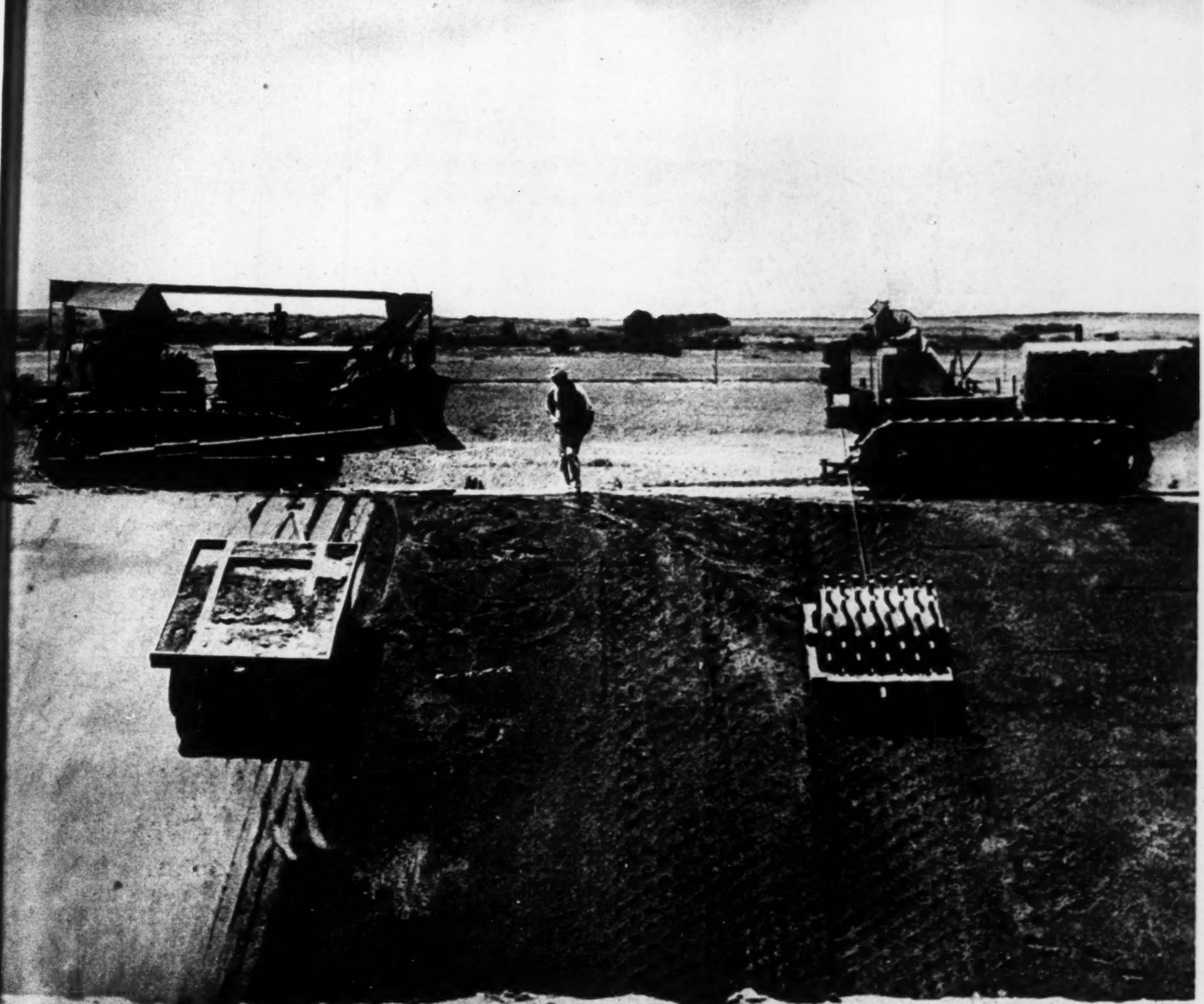
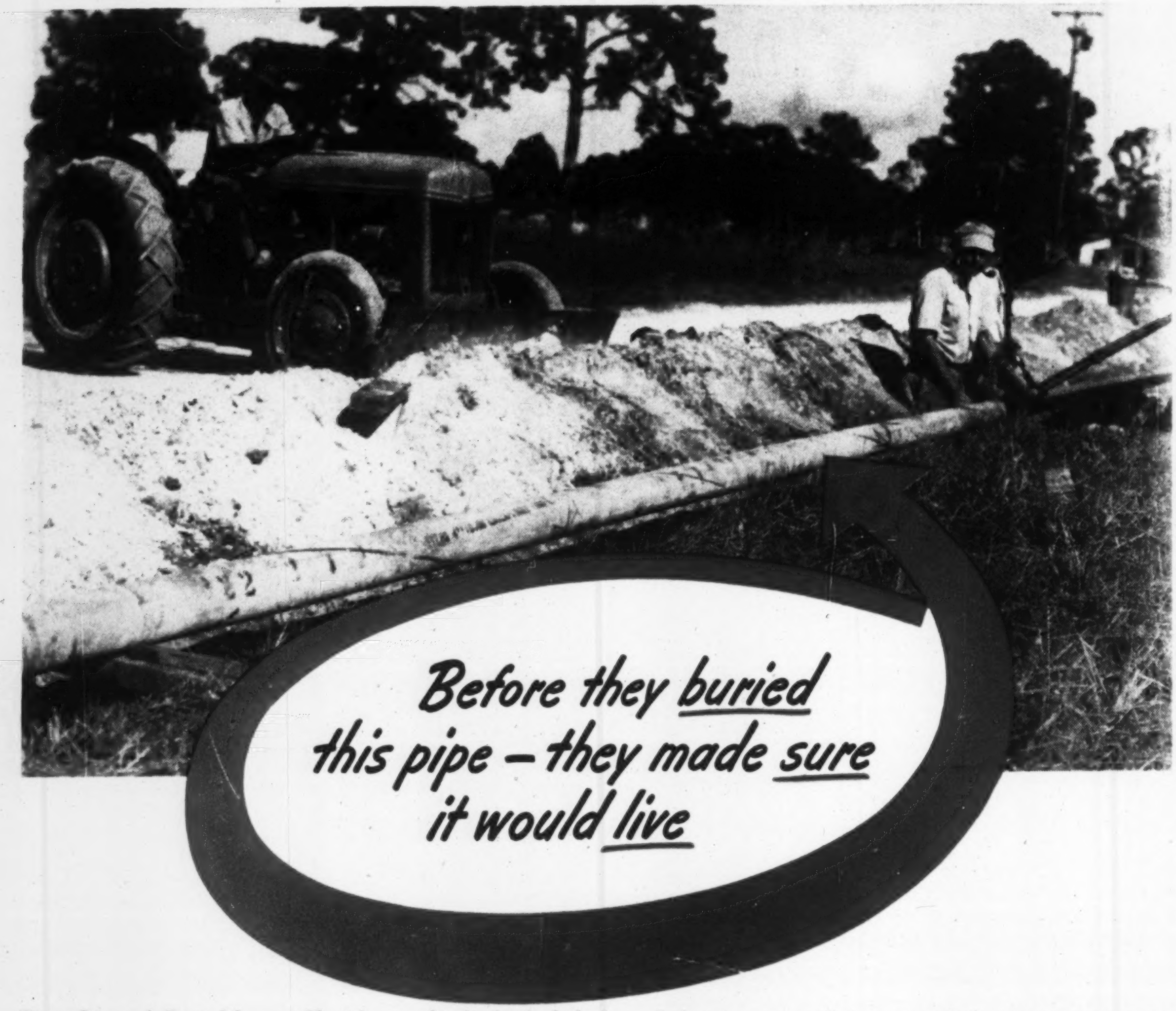


Lining a test section of the Altus irrigation canal with stabilized soil.



Before they buried this pipe – they made sure it would live

The City of Fort Myers, Florida, recently installed a high pressure natural gas underground distribution line. The authorities very properly gave careful consideration to the question of durability, for premature failures in an underground line are troublesome and costly. Due to past experience and observation, the Plant Superintendent, W. B. Gibson, was "strong for wrought iron." Four miles of 4-inch Byers Wrought Iron Pipe, and two miles of 2-inch, were installed.

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NEWS-RECORD

Volume 136 • Number 12

MARCH 21, 1946

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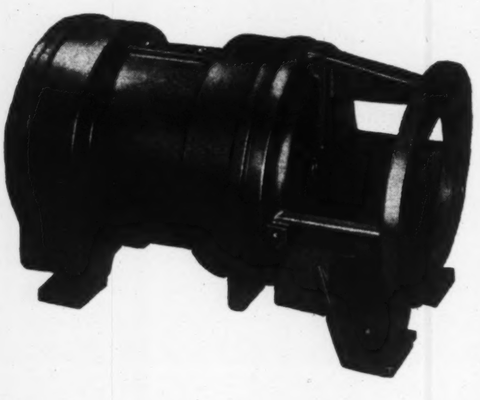

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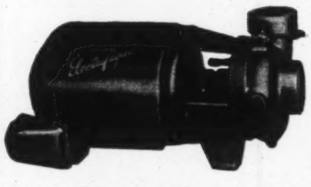

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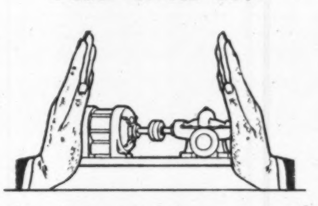
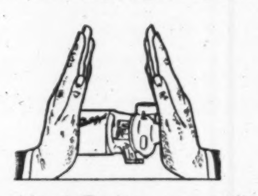


How can we couple a pump and motor together *better*—to save space, provide stability, rigid alignment?



Electrifugal Design assures alignment and smooth operation, cuts space 33% — gives you greater pumping efficiency for your money!

ALLIS-CHALMERS *Electrifugal* PUMPS

Proposed Engineering Construction Backlog

The cumulative proposed construction backlog as measured by *Engineering News-Record* through February 1946, is $29,280,103,000. This total remains after $196,661,000 worth of projects that have advanced to active status during the first two months of 1946 have been subtracted from the backlog. The backlog in February rose 1.4 percent over the cumulative total in January as against a 3 percent increase in January over the December 1945 total.

Of the total backlog to date, state, district, county and municipal work, $16,395,825,000 is 56 percent; federal work, $8,292,790,000 is 28 percent, and private projects. $4,591,488,000, 16 percent.

The $6,955,229,000 backlog allotted for earthwork, irrigation and drainage projects makes up 24 percent of the total and leads the other eight classes which follow in order: Public buildings, 21 percent; unclassified, 5 percent; highways, 13 percent; commercial buildings, 7 percent; sewerage, 6 percent; industrial buildings, 17 percent; bridges, 4 percent; waterworks, 3 percent.

Geographically the Middle Atlantic states, with a proposed construction backlog of $7,260,842,000, contribute 24 percent of the national total. States West of the Mississippi contribute 23 percent, Far West, 21 percent; Middle West, 18 percent; South, 9 percent; New England 5 percent.

Of the $196,661,000 that moved out of the proposed construction backlog into "contract awarded" status during the first two months of 1946, 46.7 and 27.8 percent went into new industrial and commercial buildings respectively. Unclassified construction got, 10.3 percent; public buildings, 7.9 percent; highways, 1.4 percent; earthwork and drainage, 1.3 percent; sewerage, 1.1 percent.

Geographically, the Western regions lead the construction advance to active status as states West of the Mississippi contributes 31 percent of the nation's total. Far Western states 21 percent and Middle Western states 17 percent. Southern states make up 13 percent. Middle Atlantic 11 percent and New England 7 percent.

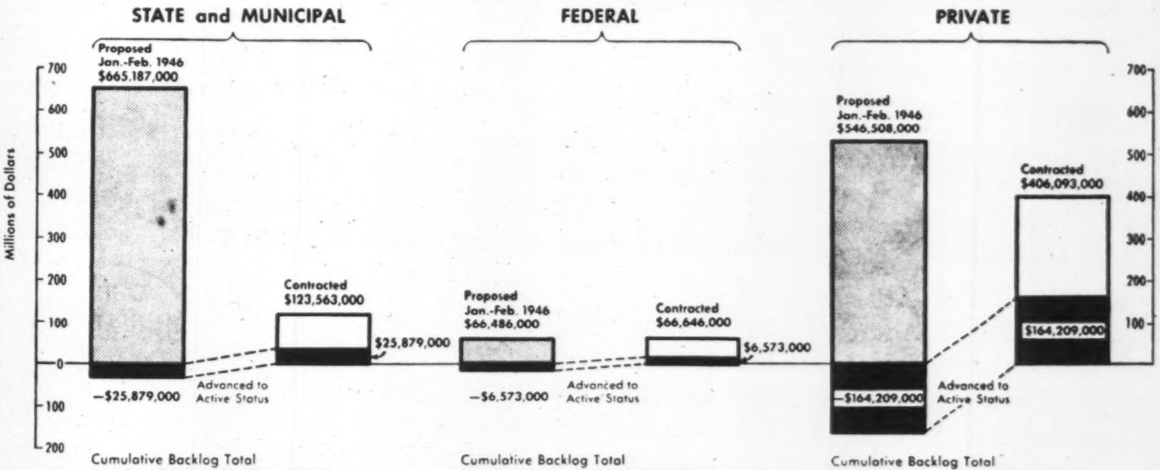
ENR MEASURED BACKLOG OF PROPOSED CONSTRUCTION
(Thousands of Dollars)

Class of Work	Backlog	% of Total
Waterworks	$903,744	3
Sewerage	1,624,237	6
Bridges	1,154,817	4
Earthwork—Drainage	6,955,229	24
Streets—Roads	3,814,693	13
Public Buildings	6,187,674	21
Industrial Buildings	1,493,962	5
Commercial Buildings	2,154,095	7
Unclassified	4,991,652	17
	$29,280,103	100

Regions	Backlog	% of Total
New England	$1,436,868	5
Middle Atlantic	7,260,842	24
Southern	2,631,345	9
Middle West	5,220,963	18
West of Mississippi	6,675,826	23
Far West	6,054,259	21
Total Feb. 28, 1946	$29,280,103	100

CONSTRUCTION ACTIVITY ANALYSED–JANUARY and FEBRUARY 1946

New Construction Proposed, Advanced to Active Status, and Contracts Awarded



Cumulative Backlog Total	
Dec. 31, 1945	$15,730,638,000
Jan.-Feb., 1946	665,187,000
Total To Date	$16,395,825,000

Cumulative Backlog Total	
Dec. 31, 1945	$8,226,304,000
Jan.-Feb., 1946	66,486,000
Total To Date	$8,292,790,000

Cumulative Backlog Total	
Dec. 31, 1945	$4,044,980,000
Jan.-Feb., 1946	546,508,000
Total To Date	$4,591,488,000

ENR Business News

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News of the Week

ENGINEERING NEWS-RECORD • MARCH 21, 1946 • VOLUME 136 • NUMBER 12

Housing prospects analyzed in light of material needs

Shortages of key materials will limit housing to about two-thirds of announced goal—Other construction, except buildings, should be little affected

The probable effect of the federal government's new housing program on the size and pattern of 1946 construction began to emerge last week, with the release of materials requirements data by the Civilian Production Administration, and a study by the McGraw-Hill economic staff. Indications are that:

1. All types of engineering construction—except public, commercial and perhaps industrial buildings—will reach the 50 percent increase over 1945 predicted earlier in the year.
2. Production requirements for materials that are imposed by the planned housing program are so tremendous that there is doubt that they can be met in the remaining months of 1946.
3. The so-called housing shortage is not as serious, from one point of view, as has been claimed—that the country is, in fact, better housed now than it was in 1940. This latter conclusion is based upon the fact that between three and one-half and four million residential units were added during the war through new construction and remodelling, while the number of non-farm families increased by less than 3½ million. Even assuming that some of the housing built during the war, is now unsuitably located, the useful increment of new housing is substantial.

Another situation bearing on the need for new housing, is the "doubling up" of families, yet even on this score, the nation is better off than before the war, the economists said. Figures suggest that families now living "doubled up" (estimated at 1,200,000 at present) represent a total only one-third as great as it was in 1940.

"The principal reason that we have a shortage," the McGraw-Hill survey concludes, "is not that the supply of new homes has failed to keep pace with the increase in number of families, but that there is a demand for better housing than we had before the war. Moreover, incomes are higher, so people can afford better homes."

Briefly, the federal government, under leadership of Wilson W. Wyatt, National Housing Expediter, proposes to spur the start of construction on 1,200,000 homes in 1946 (including 650,000 conventional type, 250,000 prefabricated, 200,000 temporary structures, 50,000 conversions and 50,000 trailers), and on 1,500,000 homes during 1947.

What the impact of this program will be on construction volume cannot be accurately appraised until the terms of a limitation order now being drafted are made public. This order is expected to follow the lines of the wartime curtailment order L-41, bearing on non-essential and deferrable construction.

However, on the basis of the CPA and other figures now available, the McGraw-Hill economic staff, in its analysis, foresaw the probability of a 25 percent cut in industrial construction over the previously forecast level for 1946, and a 23 percent reduction in commercial construction. The forecast predicted little, if any, cut in other types of construction—such as highways, utilities and the like

(Continued on page 56)

N.Y. shares builder's saving on contract

After reaching an unusual agreement whereby the city will allow the contractor extra leeway for "unusual contingencies" but retain a major share of any savings, the New York City Board of Water Supply awarded a $14,300,000 contract to the S. A. Healy Co., of White Plains, N. Y., for completion of the Merriman Dam, at Lackawack, N. Y.

The board said work on the dam—halted by wartime restrictions—will be resumed at once.

"The board's decision to make this award," an official statement said, "was the result of an offer from the Healy Co. under which the company agrees to share with the city amounts which the company would otherwise be entitled to receive under the bid.

"In accordance with an agreement made with the Healy Co., the city will retain 80 percent of the difference between the true necessary actual cost of the work, plus a reasonable allowance for overhead and profit, and the final amount of the contract—using the unit bid prices.

"This places the city in position to recover four-fifths of sums included in the Healy company bid to provide for unusual contingencies."

Earlier bids on the same project were rejected (*ENR* Sept. 27, 1945, vol. p. 400) when costs were said to be "higher than anticipated." These earlier bids, five in number, ranged from $13,919,950 to $19,121,050. An analysis of these bids and comparison with those originally received in August, 1939, appeared in *ENR* Sept. 27, 1945, vol. p. 400. Mason and Hanger held the original contract and completed most of the work, except the rolled fill, before the contract was canceled.

After rejecting bids in September, the board statement said, additional studies and investigations were made, and the contract modified with a view toward obtaining lower prices.

"The desired result was not obtained," the statement added. "The board is convinced that lower bids for the work will not be forthcoming in the immediate future. To wait for the economic situation to improve would mean a delay of at least another year in completion of the dam. The board . . . is therefore under obligation to carry the . . . project forward with all possible speed."

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Housing—First concrete was poured recently for the $25,000,000 Wynnewood development at *Dallas, Tex.* planned for 2,200 housing units on an 820-acre site. . . . The *Ohio* Urban Redevelopment Commission estimated 57,000 units would be needed by the end of 1946. . . . *Hennepin County, Minn.*, commissioners in a formal resolution protested use of prefabricated housing and asked lifting of ceilings on building materials. . . . *St. Louis, Mo.*, began construction of three "test" houses, to cost a maximum of $5,000 to $6,000 each.

Bond issues—*Reno, Nev.*, approved a $1,500,000 issue to finance new school buildings. . . . Voters of *Euclid—Cleveland, Ohio*, suburb—approved a $916,000 issue for school expansion. . . . *Monett, Mo.*, approved a total of $64,000 to finance in part expansion of the sewer system. . . . *Peoria, Ill.*, set April 9 as date for a vote on a $2,460,000 issue to construct a new courthouse. . . . *Delevan, Ill.*, issued $130,000 to finance extensions to its sewage system.

Hospitals—A $13,718,000 hospital building program is planned for the State of *Washington*—18 institutions planning additions, and eight new buildings to be built. . . . Two new hospital projects, totalling $1,500,000 are planned for *Minneapolis, Minn.*

School building—An expenditure of nearly $1,000,000 in new school buildings and additions is planned at *Cleveland, Ohio*. . . . Construction of $1,679,000 worth of buildings for a new *Santa Ana, Calif.*, junior college will start shortly. . . . Macalester College. *Minneapolis, Minn.*, will start work on a $250,000 women's dormitory.

Industrial building—Burdine's department store planned a $1,000,000 new building program at *Miami, Fla.* . . . *St. Paul, Minn.*, reported industrial building expansion programs totalling $15,927,000. . . . By the end of February, *Memphis, Tenn.*, had issued more than $4,000,000 worth of building permits. . . . Sears, Roebuck and Co. planned a $2,000,000 store and warehouse at *Greensboro, N. C.* . . . The British Columbia Electric Railway Co. planned a $600,000 addition to its gas plant at *Vancouver*. . . . In the first six months of 1946, *Baltimore, Md.*, builders have started construction on 1,900 new buildings.

Highways—*Pennsylvania* received bids on 21 highway projects. . . . *Oregon* has let over $7,000,000 in road contracts to date. and expects to have $5,000,000 more work under way by July. . . . Because of high costs, *Arkansas'* road program will be cut 40 percent for 1946. . . . *Maryland* will open bids March 26 on $2,500,000 in primary road improvement work.

Sewage disposal—*Chapel Hill, N. C.*, will spend $316,000 to improve its disposal system. . . . *East Moline, Ill.*, planned a $935,000 sewer and waterworks expansion project. . . . *Bossier City, La.*, will spend $123,000 on sewer and drainage facilities.

Miscellany—Southern Union Gas Co. and the Albuquerque Gas and Electric Co. plan a $1,500,000 pipeline extending from *San Juan County, N. M.*, to *Sante Fe*. . . . Three small-boat harbors will be built as part of a park development program for *Rochester, N. Y.* . . . *Houston, Tex.*, created a zoning department. to draft a new ordinance. . . . *California* will build a $250,000 fish hatchery at *Victorville*.

◆

Litigation continues over engineer's fee

Seeking to sidestep long drawn out lower court proceedings, two San Francisco attorneys recently filed a suit in California's Supreme Court which would compel payment by the city of $10,000 to Clyde Kennedy, consulting sanitary engineer. The sum represents an initial installment due Kennedy on a contract entered into with the public works department last September.

A taxpayer's suit brought two months ago against city Controller Ross by the Municipal Civil Service Association would enjoin him from compensating Kennedy to the amount of $70,000 for designing a sludge treatment plant, with the Civil Service holding the view that their engineers' jobs would be endangered if private enginers were allowed to design city projects (*ENR* Jan. 31, 1945, vol. p. 161). Until the case is settled, Harry Vensano, public works director, is holding up all civic construction planning which involves private engineers.

To break the stalemate by settlement of the dispute is strongly desired by the Association of Consulting Engineers of California.

Award shaft contract Brooklyn-Battery tunnel

The Grow Construction Co. of New York City has been awarded a $3,594,580 contract for sinking the Governor's Island shaft of the Brooklyn-Battery tunnel in New York City.

The company is a new firm, headed by Charles Goodman—formerly of Herman Goodman Co., subway builders, and Joseph J. Elkins—until recently head of the Woodcrest Construction Co.

The shaft is required to provide ventilation midway in the 2-mile long, twin-tube vehicular tunnel which will connect downtown Manhattan and Brooklyn. The 110 x 50-ft. shaft will come down over both tubes to intersect them in rock at a depth of 90 ft.

The contract includes construction of a "land structure" on the northeast side of Governor's Island. The contractor's plan is to build this land area up first, and then sink a caisson through it.

Calendar of Meetings

NATIONAL

National Society of Professional Engineers, conference of state presidents of member state societies, and board of directors meeting, Deshler-Wallick Hotel, Columbus, Ohio, March 29-30.

American Concrete Pipe Association, 38th annual convention, Edgewater Beach Hotel, Chicago, Ill., April 11-12.

American Society of Civil Engineers, spring meeting, Bellevue Stratford Hotel, Philadelphia, Pa., April 17-19.

REGIONAL

New York Section, American Water Works Association, Mark Twain Hotel, Elmira, N. Y., March 28-29.

Indiana Section, American Water Works Association, Union Building, Purdue University, Lafayette, Ind., April 2-3.

Canadian Good Roads Association, annual convention, Chateau Frontenac, Quebec City, Canada, April 2-5.

Canadian Section, American Water Works Association, annual convention, General Brock Hotel, Niagara Falls, Ont., April 8-10.

Montana Sewage Works Association, Butte, Mont., April 11-12.

Montana Section, American Water Works Association, Finlen Hotel, Butte, Mont., April 12-13.

Arizona Sewage and Water Works Association, Tucson, Ariz., April 18-20.

Florida Engineering Society, 13th annual meeting, Jacksonville, Fla., April 25-27.

AREA seeks means to attract new men for engineering work on railways

Need for many more engineers discussed at meeting of American Railway Engineering Association — Research work to be expanded

The plight in which the railroads of this country now find themselves, due to their continued failure to attract technically trained men came up for active consideration at the annual meeting of the American Railway Engineering Association, held in Chicago March 12-14.

Discussion of means of correcting this situation, and planning for expansion of research work were high spots of the meeting. Due to the congested hotel situation, no exhibit was held by the National Railway Appliances Association in connection with the convention, as was customary before the war.

James B. Akers, of Washington, D. C., was elected president, succeeding A. A. Miller, of St. Louis, chief engineer, maintenance-of-way, Missouri Pacific R. R. C. J. Geyer, general manager, Chesapeake & Ohio Ry., was advanced to first vice-president and Armstrong Chinn, chief executive of the Alton Railroad, was elected second vice-president. Honorary memberships in the AREA were presented to Ralph Budd, president of the Burlington Lines and to J. M. R. Fairbairn, retired chief engineer, Canadian Pacific Ry.

Better research needed

In his presidential address, A. A. Miller stressed the importance of accelerating research in the field of railway engineering. Consistent with the changing times, a complete reappraisal of AREA committee studies and research procedures is warranted to make certain that the association is proceeding along lines that will produce the most valuable and beneficial results in the interest of better, safer or cheaper railway transportation, he said.

There were no new research projects authorized during the past year but it is hoped, this year, to intensify investigations of the type of rail failures known as "shelly spots." Funds appropriated by the Association of American Railroads to its Engineering Division, of which the AREA is a part, for a continuation of research this year amount to $153,500.

Graduates should be attracted

One of the most vital problems facing the railroads today, according to Mr. Miller, is the development of measures that will attract to the industry, and retain in its service, a proportionate share of well qualified graduates of engineering colleges and universities. One of the primary tasks is to convince railroad management of the obvious and fundamental importance of this problem, he said.

Shortage of engineers

Despite the almost universal adoption of accelerated training programs in colleges and universities during the war, the supply of fully trained engineering graduates was reduced so drastically that at least a college generation of engineering graduates has been lost throughout the country, asserted Henry T. Heald, president, Illinois Institute of Technology. He predicted that it would be 1949 before a normal number of engineering graduates is again produced.

Speaking of the implications to the railroads of this lack of sufficient graduate engineers, Mr. Heald declared that reasonable estimates indicate that the deficit may easily reach 150,000 by 1950.

Moreover, declared Mr. Heald, it is a well known fact that railroad employment is not at present attractive to engineering graduates. This is not because the engineering colleges fail to produce men with proper training for railway engineering work. It is due to the fact that the opportunities for engineering graduates in the railroad industry do not look particularly attractive at the present time.

New AREA president

James B. Akers, recently (Feb. 1) appointed chief engineer of the Southern Railway System, was elected president of the AREA as a part of that organization's annual meeting at Chicago last week.

A native of Danville, Va., Mr. Akers is a graduate of Washington and Lee University, and joined the Southern Railway in September, 1904.

The solution to this problem, warned Mr. Heald, is not to be found in encouraging colleges to give more courses in railway engineering. Rather, it is the responsibility of the railroad industry to convince the colleges as well as their students that railroad salaries and opportunities for professional growth and advancement are equal to or better than those offered in other industries.

He added that the railroads have no realistic training program for college graduates and seldom do they try to secure students for cooperative training.

Roadbed stabilization

Stabilization of railroad roadbeds by pressure grouting with cement grout received marked attention both in the report of the association's Committee on Roadway and Ballast and in an illustrated talk by Prof. Ralph B. Peck, University of Illinois.

In presenting the first progress report on a roadbed stabilization study begun last May in cooperation with the University of Illinois, the committee and Professor Peck gave detailed information on techniques of grouting operations employed on five railroads as analyzed in the study.

"We are not yet in a position to say just what are the best methods of roadbed grouting," said Prof. Peck, "but by continuing these studies over a period of years we hope to obtain sufficient data to settle the controversial question of stabilization by grouting."

Subgrade material at every location where grouting was indicated was a clay of medium to high plasticity. No sands, silts or even silty clays were encountered below ballast pockets.

It was also found that the use of air-entraining cement and 10 percent loess improved the grout mix, giving it a smoother texture so that it could flow freely, and reducing segregation of the materials. Furthermore, it was noted that there is a direct relation between subgrade soils requiring stabilization by grouting and soils causing pumping of highway pavement. The committee suggested that further investigations be made to learn whether, in northern latitudes, soft spots have occurred in any types of soil except clays of medium to highway plasticity. Also that additional studies be made on railways in the south to ascertain whether any special conditions occur in that part of the country.

Traffic fatalities at grade crossings plus those involving trespassers on rail-

(*Continued on page* 58)

Housing program limited by materials

(Continued from page 53)

—which do not compete with but rather supplement housing construction.

Because lack of building materials will be the limiting factor in homebuilding this year, an understanding of the supply situation for important materials is a necessary prerequisite to an evaluation of the Wyatt program.

Materials construction bottleneck

Dimensions of the construction program to be used in estimating materials requirements, are not too well established. Prior to Wyatt's housing program the building of 400,000 to 500,000 homes was contemplated—within a construction program for 1946 of about $7.5 billions.

Adding the Wyatt program would lift the 1946 new construction total to $9 or $10 billions—more than double the value of all new construction in 1945 and probably beyond the industry's capacity this year. Nevertheless, CPA has based its estimates of materials requirements on the $9-$10 billions requirements program, on the grounds that only by setting forth the requirements for all demands could the magnitude of the building materials problem be visualized and the proper policy declarations be made.

Production potentialities

The production record of building materials since 1939 has been compiled by the CPA, and is shown in the accompanying table. The basic fact that will be noted is the tremendous increase in materials production rates that would be caused by imposing the enlarged housing program on all other legitimate demands. What are not so evident are the obstacles that lie in the way of achieving the necessary increases in each different material. These obstacles may be shortage of labor, inadequate plant facilities, or both.

The last two columns of the table, added to the CPA data by *Engineering News-Record* from the best presently available sources, give some insight into the requirements with respect to plant capacity to meet the 1947 or maximum housing goal. Thus, it will be seen that no additional physical plant is required for lumber, structural clay tile, asphalt roofing, clay sewer pipe, cast iron soil pipe and cast iron radiation. On the other hand, except for asphalt roofing (and it may be curtailed by a shortage of dry felt) all of these materials are being produced in far from necessary quantity—the principal reason being shortage of labor, disregarding for the moment the effect of inadequate price ceilings that continue to keep many manufacturers from vigorous, all-out, activity.

Brick must be added to the above list of materials suffering from a severe labor shortage, but it also will require a 12 percent increase in physical plant to meet the 1947 requirement.

For all other critical building materials on the list, new physical plant requirements are so large as to outweigh the effects of any labor shortage.

Thus, to meet the 1947 production goals, an 80 percent increase in physical plant would be required for softwood plywood; a 280 percent increase for building block; a 38 percent increase for gypsum board; 37 percent for other building board; 100 percent for warm air furnaces, and 30 percent for tubs.

Such figures for additional plant capacity are of course not absolute. They would be changed by substitution of one material for another—as steam or hot water systems for warm air furnaces. They could be reduced by more intensive operation of existing facilities. And finally they are based on the hypothetical assumption that the Wyatt housing program would be superimposed on all other construction, an unlikely possibility. Nevertheless, the plant increase figures point up the materials which present the greatest problems.

A realistic view

Shifting ground to the more realistic view of a $7.5 to $8 billion overall construction program—probable after limitation of other types of construction—the Mc-Graw-Hill analysis make it appear that materials can be provided to start from 80 to 90 percent of the 650,000 conventional homes called for, with prefabs an unknown quantity, but with most of the conversions and temporary housing units being taken care of:

To get any closer to the target would mean diversion of materials from construction which may be more essential than housing. As it is, the emphasis on housing will increase immensely the difficulties of carrying on essential nonresidential construction by causing delays in securing authorization to begin work, and in securing materials in a shortage market, by forcing builders to substitute materials for those essential in housing, and by increasing the difficulties of securing construction manpower. *Copies of the full report are available at 25 cents each, from the McGraw-Hill Publishing Co., 330 W. 42nd St., N. Y. 18, N. Y.*

PRODUCTION AND REQUIREMENTS OF SELECTED CRITICAL BUILDING MATERIALS (ALL CONSTRUCTION)

(From CPA report, except last two columns.)

	Monthly Average				Probable Current Production	Average Monthly Requirements		Estimated Present Productive Capacity of Fully Utilized*	Additiona Productive Capacity Needed to Meet Goals† %
	1939	1941	1942	1945		1946	1947		
Lumber (million board feet)	2,382	3,045	3,028	2,280	1,447	3,000	3,200	3,000	0
Softwood Plywood (million sq. ft., 3/8 in. basis)	80	140	155	100	100	175	280	155	80
Brick (Common and Face) (millions of bricks)	393	412	282	191	238	420	450	400	12
Structural Clay Tile (000 short tons)	97.0	93.8	87.1	62	69	110	100	95	0
Building Blocks (millions)	34	n.a.	n.a.	n.a.	30	67	84	30	280
Gypsum Board and Lath (million sq. ft.)	129	231	200	174	214	325	344	250	38
Other Building Boards (million sq. ft.)	n.a.	187	n.a.	225*E*	225	320	340	250	37
Asphalt Roofing Materials (million squares)	4.2*E*	4.8*E*	5.9	5.6	5.5	6.2	6.3	6	0
Clay Sewer Pipe (000 short tons)	89.7	n.a.	115.0	58.1	85	125*A* 110*B*	125*A* 110*B*	115	0
Cast Iron Soil Pipe (000 short tons)	24.6	47.1	n.a.	16.8	27.5	40*A* 52*B*	40*A* 57*B*	45	0
Cast Iron Radiation (000 sq. ft.)	5,018	7,007	4,972	1,400*E*	1,931	5,875	6,040	6,000	0
Warm Air Furnaces (000 units)	36.6	47.3	23.4	29.7	25	80	91	95	100
Bath Tubs (000 units)	74	98	n.a.	25*C*	65	120	130	100	30

A If use of pipe more than 5 ft. beyond the house is prohibited.
B If pipe is extended to street sewer as called for in most building codes.
C 50,000 bathtubs programmed per quarter (Jan. 1944—June 1945). The quota was never met.
E Estimated.
n.a. Not available.
* Assembled and estimated by Engineering News-Record.

Expedite delivery of prefab supplies

Housing prefabricators were granted government assistance in obtaining a long list of supplies needed in their work under an order issued by the Civilian Production Administration March 15. The order was issued as Direction 8 to Priorities Regulation 33, which originally went into effect early in January (*ENR* Jan. 10, vol. p. 13).

At the same time, CPA issued softwood priority order designated Direction 1A to PR-33, changed the lumber order by amending direction 1 to PR-33 and added to the list of materials that were placed under priority distribution when PR-33 became effective. Simultaneously, as part of the program to assist housing construction, the Office of Price Administration announced a price increase on the thicknesses of plywood needed for housing work.

The National Housing Agency's goal for the prefabrication industry has been set at 250,000 units this year and 600,000 in 1947. This industry may now obtain priorities assistance for the following materials: gypsum board and lath, millwork—including doors and built-in kitchen cabinets—lumber, insulation board, other wallboard, softwood plywood, hardwood flooring, cast iron soil pipe and fittings, clay sewer pipe, prefabricated sections and prefabricated panels, and bathtubs.

Prefabricators wishing assistance should make application directly to the CPA, Social Security Bldg., Washington 25, D. C. They should use application form CPA-4415.

Under direction 1 to PR-33, which is aimed at increasing plywood for housing work, producers are instructed as follows: Each plywood manufacturer is to produce and reserve each month, beginning in April 1946, 45 percent of his total softwood plywood production in interior (moisture resistant) and exterior construction grades and five percent in door plywood. The interior type construction grades which must be produced are ¼ and ⅜-in. wallboard; ¼ and ⅜-in. sound one side plypanels; ⁵⁄₁₆, ⅜, ½, and ⅝-in. sheathing; while the exterior type construction grades are: ¼ and ⅜-in. sound one side plypanels. Not more than 20 percent of the construction plywood reserve can be produced in exterior types. The door plywood must be in interior or exterior type ¼-in. sound two sides plypanels.

The list of selected critical building materials (schedule A of PR-33) on which HH preference ratings apply was amended to include: softwood plywood, hardware floorings, prefabricated houses, sections and panels. The other materials listed in schedule A are: millwork, lumber, gypsum board and lath, bathtubs, cast iron soil pipe and fittings, clay sewer pipe, cast iron radiation, structural clay tile, common and face brick and concrete blocks.

Principle changes brought about by amending Direction 1 to PR-33 or the lumber order are as follows: Revision of the definitions of a sawmill and hardwood flooring lumber; revision of the hardwood flooring production reserve instructions; inclusion of prefabricators; time extension for jobbers; and clarification concerning what sawmills can accept HH rated orders and in what circumstances certified orders do not take precedence over other orders.

Hardwood flooring lumber is redefined in Direction 1 to mean grades 2A and 3A rough, in all thicknesses of oak, pecan and beech; in 4/4 and 8/4 thicknesses of hard maple and in 4/4 and thinner thicknesses of birch.

◆

Pittsburgh—Allegheny County Pa., will contribute $5,000,000 to the $6,000,000 set by the state as the share of Pittsburgh and the county toward the cost of the $31,000,000 Penn-Lincoln Parkway from east of Wilkinsburg to downtown Pittsburgh.

E. J. Taylor named chief, Philadelphia water bureau

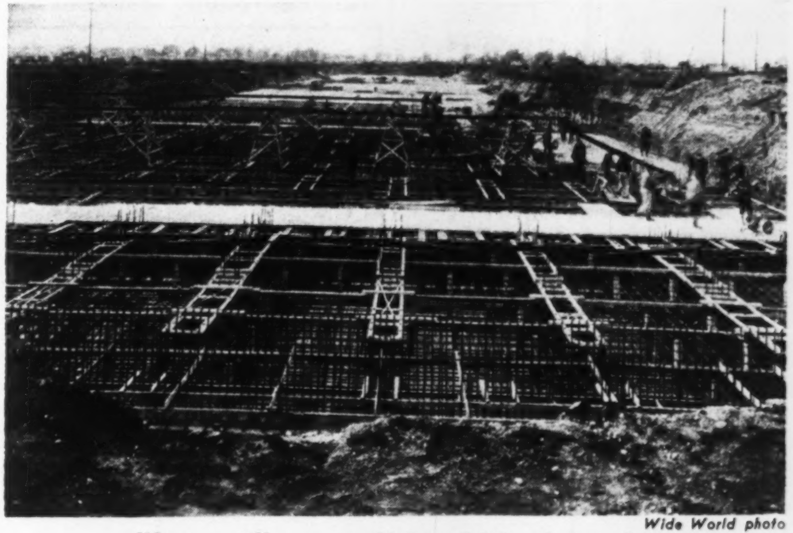
E. J. Taylor

Elbert J. Taylor, a consulting engineer, has been named chief of the Philadelphia, Pa., Bureau of Water. He has been associated for more than 20 years with Morris Knowles, Inc., Pittsburgh, Pa., consulting engineers, under contract with the city on rehabilitation of Philadelphia's water supply system. Since 1940, he has been his firm's resident engineer in Philadelphia.

Mr. Taylor fills a vacancy created last September when Martin J. McLaughlin was appointed Director of Public Works, succeeding the late John H. Nesson.

Mr. Taylor is a graduate in civil engineering from the University of Cincinnati. From 1923 through 1925, he was an engineer on the Cincinnati division of the Pennsylvania Railroad engaged in bridge construction.

Under a graduated rise the salary for this position increases to a maximum of $9,000. There were 30 applicants for the place after it had reportedly gone begging for some time because, it was said, the salary was not considered adequate. (*ENR* Nov. 8, 1945, vol. p. 636).



Wide World photo

"Largest" press pit has 36-in. floor slab

Construction of what is said to be the largest press pit in the world is under way at the site of a new stamping plant for the Fisher Body Division of General Motors to be located at Hamilton, Ohio.

The pit will be 800 ft. long, 160 ft. wide and 20 ft. deep, to accommodate more than 100 presses—some of them weighing up to 500 tons and capable of stamping out an entire car-top at a single blow.

Pouring of the 36-in. reinforced concrete floor slab is in progress above.

Conservation agency may enjoin pollution

Ohio attorney general says stream pollution injurious to wild life may be halted—other developments.

The Ohio Conservation Division has authority to obtain injunctions to halt stream or lake pollution that destroys wild life, according to an opinion handed down by Ohio Attorney General Hugh S. Jenkins.

Mr. Jenkins held that the division could obtain injunctions to prohibit any pollution harmful to wild life, and that it could also sue for damages in the case of water contamination.

H. A. Rider, commissioner of the division, said that the opinion was a powerful weapon in the hands of his group to combat pollution of the state's streams and lakes. Mr. Rider said he was hopeful of greater cooperation from interests that have contaminated streams, and expressed the opinion that federal legislation should be enacted to regulate stream pollution.

Add to Pennsylvania staff

Sixteen engineers have been added to the staff of the Pennsylvania State Sanitary Water Board, according to Howard E. Moses, chief engineer for the State Department of Health. Mr. Moses said the personnel increase was the initial stage of an expansion resulting from the State's Stream Clearance Program.

Virginia considers legislation

Gov. William M. Tuck of Virginia indicated last week he was willing to consider recommending ratification by the Virginia Legislature of an 8-state agreement proposing joint action in anti-pollution activities. He added, however, that such a course would be followed provided it did not appear to interfere with passage of a state anti-pollution act which the governor had already endorsed. The remaining seven states—Ohio, New York, Kentucky, Indiana, Pennsylvania, Illinois and West Virginia—favored joint action for the Ohio River Valley sanitation compact.

◆

See strong opposition to Klamath diversion

New and vigorous opposition was expected last week, when it was learned that the Bureau of Reclamation will begin a study of the Klamath River basin as soon as weather conditions permit.

U. S. Engineers touched off original opposition in northern California and southern Oregon last year with their recommendation that surplus water of the Klamath be diverted to California's Central Valley project, to be used for power generation and irrigation in the Sacramento and San Joaquin valleys. (*ENR* March 8, 1945, vol. p. 300)

In opposition to the Army Engineers, citizen's committees and state legislatures went to work to prevent the proposed diversion. High Army officials, after several public hearings, quieted the controversy with statements that the proposal would not materialize against the will of the people in the region. Bureau spokesmen, at the time, denied all part of the deal and expressed doubt that the Central Valley would ever need any more water than could be provided by a series of dams up and down the watersheds of the Sacramento and San Joaquin rivers.

However, with the bureau survey of the Klamath and its tributaries now a certainty, their spokesmen in the Region II office, Sacramento, last week failed to deny that the diversion plan was to be left out of the calculations, and expectations are that the touchy subject may flare up again. Bureau officials admit that, when all needs of the Klamath basin water users are taken care of, the diversion plan may be feasible if the Central Valley should need the surplus. They claim the report written as a result of their forthcoming study will be more specific and detailed than was that of the army engineers.

Crews for conducting the survey are now being assembled in the Bureau's Sacramento office, and headquarters will be set up in Klamath Falls, Ore., not later than July.

No change planned in veterans' priority

Priorities for scarce building materials issued under the present Veterans' Preference Rating System will remain valid and will not be affected by any change in regulations under the Veterans' Emergency Housing Program, Wilson W. Wyatt, national housing expediter, said last week.

Builders were assured that all HH preference ratings which have been issued and are currently being issued will be honored by suppliers for eleven building materials now in extremely short supply.

"There is no intention to check construction of homes progressing with priority assistance, and the orders being developed to tighten controls over materials in accordance with the emergency program will not prevent the completion of priority housing under construction," Mr. Wyatt said.

AREA sees shortage of railway engineers

Discuss means of attracting new men

(*Continued from page* 55)

road property account for 66 percent of all fatalities from railroad operation, declared John R. Tenney, superintendent of safety, Western Maryland Ry. Latest available statistics disclose that during 1944 there were 1,840 grade crossing fatalities and, since the end of gasoline rationing, there has been a noticeable upturn in the number of such accidents.

To combat this unwarranted traffic toll, said Mr. Tenney, an accident prevention program is now getting under way, sponsored jointly by the safety section of the Association of American Railroads and the steam railroad section of the National Safety Council.

New design formula

On recommendation of the Committee on Iron and Steel Structures, the association adopted changes in its manual simplifying the formulas for distribution of live load on steel railway bridges. Where the track is carried on transverse steel beams without stringers, the portion of any axle load on a single beam shall be computed by the formula:

$$P = \frac{KAd}{S}$$

where:

A = Axle load.
P = Load on a beam from one track.
d = Beam spacing.
S = Axle spacing.
$K = 1\frac{1}{8}$ for single track and $1\frac{1}{4}$ for double track.

Timber ties shall be designed on the assumption that the maximum wheel load on a rail is uniformly distributed over three ties, and is applied without impact. These new formulas, which supersede rather complicated old formulas in the manual, are reported to have been used for some time by certain railroads.

Electrolytic corrosion tests

Conclusions of two years' investigations by the Electrical Section, Association of American Railroads, on electrolytic corrosion of steel bars encased in concrete on electrified railroads disclosed that increasing the thickness of concrete covering of reinforcing steel reduced the rate of electrolytic corrosion but did not effectively eliminate it to prevent cracking of the concrete. On the other hand it was found that asphalt membraneous waterproofing covering of the concrete provided an effective means of eliminating corrosion of the reinforcing steel and deterioration of the concrete.

George W. Bacon retires, founder of engineer firm

George Wood Bacon, 77, one of the founders and lately chairman of the board of the engineering firm of Ford, Bacon and Davis, Inc., retired from active participation in the organization March 12.

A graduate of Cornell University in 1892, he entered a partnership with Frank R. Ford and George H. Davis shortly afterward. The firm began its long career with the contract for electrification and management of the street railway system of New Orleans, La. With this start in the public utilities field, the firm became interested in expansion of traction properties throughout the Southeast, and in Washington, D. C., Pittsburgh, Pa., Kansas City, Mo., and in New Jersey.

G. W. Bacon

During the first World War, Mr. Bacon was executive head of the export department of the J. P. Morgan & Co., and in 1919, he directed his firm's work in connection with the development of adequate water supplies for Athens and Piraeus, Greece.

In association with his partners, he was responsible for advancement in design and construction of long distance pipelines, and took an active part in the transportation of natural gas and other fuels.

Mr. Bacon recently returned from India and China.

Last concrete poured on Alva B. Adams tunnel

Last concrete in the 13.1-mi. long Alva B. Adams tunnel was poured early this month, marking another step towards the completion of the Colorado-Big Thompson project of the Bureau of Reclamation.

The tunnel, which will deliver Colorado River water to the eastern side of the Continental Divide at a rate of 4,000 gps., was begun in 1940. Work was suspended in 1942 because of material and manpower shortages, but resumed in 1943 when future food requirements indicated the advisability of rushing the irrigation project to conclusion. Work halted again in January, 1945, but started again last May. (*ENR*, May 17, 1945, vol. p. 691)

Fight Youngstown, Ohio, municipal utilities tax

Opponents of a municipal public utilities tax recently levied by Youngstown, Ohio, served notice March 8 that, despite two adverse court decisions, the case will be appealed to the State Supreme Court for a final decision.

The city council enacted the taxing measure, which became effective in February, 1945, to permit the city to collect 2½ percent on all public utility bills, including gas, electricity, telephone and water, directly from the consumer.

Immediately after passage of the ordinance, the Youngstown Real Estate Board filed suit in the county court against collection of the tax. When the suit was heard in June, the court held that the tax did not invade a field already taxed, inasmuch as the tax was against the consumer and not against the utility companies. Plaintiffs argued that the tax amounted to a sales tax and that the state had exempted public utilities because they were already taxed under the public utilities law.

The State Court of Appeals affirmed the findings of the lower court.

Pending final outcome of the suit, the tax collected to date, amounting to more than $200,000, is impounded by mutual consent.

Several other Ohio municipalities, including Columbus, have similar ordinances pending.

$20 million "made" island rises in Miami Harbor

A 45 acre, U-shaped artificial island, part of a $20,000,000 resort project, is almost complete in Biscayne Bay, between Miami and Miami Beach, Fla. Known as Harbor Island, the development will be the site of a major hotel, shopping and resort development.

Construction of the island itself, dredged up from the bay bottom, began on Dec. 27 last when dredges of the Tampa Hendry Corp. began operations.

The project is sponsored by Joe Hurt, a civil engineer, recently engaged in development of Sunset Island at Miami Beach. He is head of a group operating under the name of Sea Bay Corp. The corporation will build a 220-room apartment hotel in the heart of the development on a 7½-acre site. Other organizations have already agreed to construct another hotel, and more than half of the lots to be made available have been sold or leased, developers said.

The island is 458 ft. wide and 1,600 ft. long, with a 24 ft. deep harbor in its center.

Adm. Combs, Adm. Jelley get new assignments

Effective March 19, Rear Admiral Lewis B. Combs took over as director of the Atlantic Division for the Navy's Bureau of Yards and Docks, making his headquarters in New York City.

Adm. Combs was succeeded in his former post of assistant chief of the bureau by Rear Admiral Joseph F. Jelley, who returned recently from duty in the Pacific war theater.

A graduate of Rensselaer Polytechnic Institute in 1916, Adm. Combs entered the Navy Civil Engineer Corps in 1917 with the rank of lieutenant, junior grade, and has remained in the service continuously since that time. His service has included tours in Haiti; and the Philippine Islands, and service in the New York, Portsmouth, N. H., and San Diego, Calif., Navy yards. He became assistant to the chief of the Bureau of Yards and Docks in 1938.

Adm. Combs

Adm. Jelley

Admiral Jelley, a graduate of the U. S. Naval Academy, Annapolis, took civil engineering work at Cornell University and Rensselaer. His service includes a tour of duty in Hawaii, and service in many naval establishments in the continental United States. He served as assistant director of the construction department of the Bureau from 1942 until his assignment overseas.

Plan $15,000,000 rail terminal at Pittsburgh

The Pennsylvania Railroad Co. recently unveiled a scale model of a $15,000,000 railroad terminal which it plans to construct on the site of its present 13th Street terminal in Pittsburgh, Pa.

Plans for the structure and its facilities were made five years ago.

D. L. Somerville, chief engineer for the railroad's central region, said that first construction will be new roundhouses and turntables. Within the shell of the existing building, platforms will be widened and lengthened, escalators and new exits are planned, and separate facilities for commuters will also be provided.

Earth shock damages Los Angeles aqueduct

An earthquake at 5:50 A. M., March 15, cracked the Owens Valley aqueduct of the Los Angeles water-supply system in half a dozen places, and rolled 60 ton boulders down mountainsides, smashing six 3-ft. holes in the aqueduct and crushing in a 5-ft. high section of the 12-in. thick reinforced concrete sidewall for a distance of 12 ft., necessitating shutoff of water at Haiwee Reservoir, 24-miles above the break.

The main quake, measured by California Institute of Technology's seismological laboratory at an intensity of 6¼, with 8½ the maximum ever recorded, was preceded by a preliminary shock and followed by aftershocks which continued the shower of rock throughout Friday, preventing repair crews from working. Two aftershocks, estimated at 5¼ intensity, were recorded at 7:50 and 7:51 a. m., Monday, March 18.

Seismological crews rushed to the area by the institute are tracing the source of the quake, but to date have not determined its origin. This information is important because it is now proposed to build a dam on the Kern River, the site for which was badly shaken, according to preliminary reports.

Water flowing at near the 480 sec.-ft. capacity of the aqueduct gushed through the break at 100,000 gpm. at the peak but stopped when the level dropped below the bottom of the break. Flow was shut off at Haiwee Dam immediately after the break occurred but more than six hours were required to drain the aqueduct at the break point.

Repair crews cleared boulders from the work road to the Sand Canyon site of the break during the day Friday and rushed up forms and equipment from field storage points. Repairs were completed within 48 hours and a test flow was started, but was stopped when six small cracks were discovered five miles below the break, in a section supported by earth fill, washout of which might cause serious damage. Concrete forms at the main break were to be removed Monday when the latest after-shocks again sent down another shower of boulders.

The Owens Valley aqueduct, built in 1916, is currently the main source of water to the city of Los Angeles, but will not be the principal source in future when more water is taken by the city from the Colorado River aqueduct of the Metropolitan Water District of Southern California, built to supply Los Angeles and numerous adjoining municipalities. The Owens Valley line feeds into reservoirs in and near the city which currently contain a three-months supply.

WASHINGTON HIGHLIGHTS

Columbia Basin • A Columbia Basin Inter-Agency Committee, for the purpose of effecting the coordination of planning, construction, and administration for the multiple-purpose development programs of the Columbia River Basin and the coastal areas in Washington and Oregon draining into the Pacific, has been established by the Federal Inter-Agency River Basin Committee. The new committee will consist of one field representative each from the Federal Power Commission; Department of Agriculture; Department of the Interior; the Corps of Engineers, and the Bonneville Power Administration.

The governors of Washington, Oregon, Idaho, Montana, Wyoming, Nevada, and Utah, which lie wholly or in part in the Columbia River drainage area, will be asked to designate jointly five representatives to attend the regular monthly meetings of the committee.

A similar committee dealing with the Missouri Basin is already in operation.

Hospitals • Hearings were begun March 11 by the health subcommittee of the House Interstate and Foreign Commerce Committee on the bill (S. 191) providing extensive federal aid for hospital construction. The bill, which has already passed the Senate (*ENR* Dec. 20, 1945 vol. p. 846), authorizes a total appropriation of $375,000 for a 5-year construction program. The money will be spent through the U. S. Public Health Service and will be matched by state or local funds. In addition to the construction money, the bill authorizes $5,000,000 for surveys and planning for state-wide construction programs.

Money for Standards • The President March 6 submitted to Congress a supplemental appropriation of $1,000,000 for the National Bureau of Standards for the fiscal year 1947. This money is provided in addition to that already recommended in the 1947 budget for the Department of Commerce. The appropriation is for the purchase of materials, equipment and apparatus to improve and modernize the laboratories and other facilities at the Bureau.

Apprentices • The apprentice training service of the Department of Labor has announced that of the apprentices employed during the first six weeks of 1946 in the various skilled crafts of the construction industry, 90 percent are former servicemen. Employment in the industry accounted for 40 percent of all veterans registered as employed apprentices in all types of skilled trades.

San Bernardino fights "jerry-built" housing

An ordinance designed to protect San Bernardino, Calif., residential areas from the introduction of "jerry-built" housing has been passed by the city council. The new ordinance attempts to curb value-lowering housing by fixing minimum floor space requirements.

Minimum sizes are: single family zones, 800 sq. ft.; industrial zones, 600 sq. ft.; and multiple-family zones, 320 sq. ft. per family dwelling, but such must be parts of multiple family units.

The new ordinance, recognizing the housing shortage as a temporary emergency, permits erection of garage buildings for temporary use as homes, but limits such use to Jan. 1, 1949, and stipulates their location as at rear of lot, at least 75 ft. from front property line, and specifies sizes. In single family zones, size cannot exceed 24 ft. x 20 ft., or less than 20 ft. x 20 ft. In industrial zones they can be as small as 12 ft. x 20 ft. All garages must meet building code requirements, and be equipped with toilet, bath, heating and lighting facilities.

Urge covering stream bed in downtown Bangor, Me.

A million dollar plan to cover the Kenduskeag Creek for a distance of almost two blocks in Bangor, Me., to remove what residents claim is an eyesore and health menace, was proposed to the city commission recently.

Based on a survey made by Metcalf & Eddy, of Boston, city manager Horace M. Estey said that three plans have been proposed.

The first of these—and apparently the one favored by most residents—would be to place two concrete conduits, each 13x34 ft., in the stream bed to carry the water. Engineers estimated that these conduits would take care of any conceivable high water level on the stream. Earth would be filled in and around the conduits to raise the level of the land thus created to 21 ft., to make about 4½ acres of new land in the heart of the city. The conduits, it was said, would also eliminate objectionable odors caused when low tides leave the stream bed exposed. Other plans include construction of new retaining walls to confine the bed of the stream.

OBITUARY

Newton J. Ker, 78, who was city engineer of Ottawa, Ont., from 1902 to 1912, died in Vancouver, B. C., March 2. After leaving Ottawa he was land agent for the Canadian Pacific Railway in Vancouver until his retirement in 1936.

Harry K. Davison, 60, who during his 36 years of residence in Fort Myers, Fla., mapped nearly all of the city and county subdivisions, died Feb. 26. He went to Fort Myers in 1910 to be associated with his father, J. A. Davison, in a civil engineering firm. Later he continued as a civil engineer.

Thomas C. Stevenson, 72, civil engineer, died at Charleston, S. C., March 2. A graduate of the Citadel, in 1910 he formed the Charleston Engineering and Contracting Co. He retired from engineering several years ago and formed the Edisto Sand and Gravel Co. and the Concrete Products Co.

Henry N. Worthington, 75, president and treasurer of the Henry N. Worthington Construction Co., Quincy, Mass., died March 4. He was at one time associated with the engineering commission of the District of Columbia, later superintendent of the Bureau of Filtration, Philadelphia, Pa. and construction engineer for D. J. McNicol Co. of that city.

James Robert Welch, 35, civil engineer with the Neal Hawkins Construction Co. of Gastonia, N. C., died March 1.

Charles Findlay Barclay, 74, construction engineer and former superintendent of the construction firm of John Quinlan Ltd., died at Verdun, Que., March 6.

Robert Hughes, 81, chief engineer for the Philadelphia, Pa., Board of City Trusts until his retirement in 1942, died March 4 at Media, Pa.

Earl J. W. Ragsdale, 61, chief engineer of the railway division of the E. G. Budd Mfg. Co., died Feb. 24 at Norristown, Pa.

John C. Davis, 67, former director of the Citizens Bureau of Milwaukee, Wis., died March 10. He had been a civil and highway engineer in New York State and a professor at Cornell University. He went to Milwaukee in 1908 to organize Marquette University's engineering school where he was dean until he became chief of municipal research.

Francis S. Adamson, 42, deputy city engineer of Winnipeg, Man., died March 6. He was graduated from the University of Manitoba in 1926.

Christ Vogt, 77, civil engineer in the Allen County Surveyor's Office, Fort Wayne, Ind., died Feb. 13 in that city.

John Bernard Breymann, 87, Toledo, Ohio, harbor construction man, died March 5. With his brothers, Eugene and George, he founded the Breymann Bros. Dredging Co., for many years active on the Great Lakes and along the eastern seaboard.

Ralph Clark Chaney of Cleveland Heights, Ohio, died recently in Gainesville, Fla. At the time of his retirement last July he was Cleveland's planning engineer for the State of Ohio.

Alan N. Jordan, 70, Portsmouth, Ohio, authority on flood control and conservation, died Feb. 17 in Cincinnati. He was executive secretary of the Ohio Valley Flood Control and Conservation Congress, and was with it since its inception in 1932.

Stanley H. McKee, Youngstown, Ohio, consulting engineer, died March 4. For 25 years he had been an engineer with Republic Steel Corp. For the last eight years he was with Youngstown Welding and Engineering Co. He also served on the engineers' advisory committee of the Mahoning VaVlley Sanitary District.

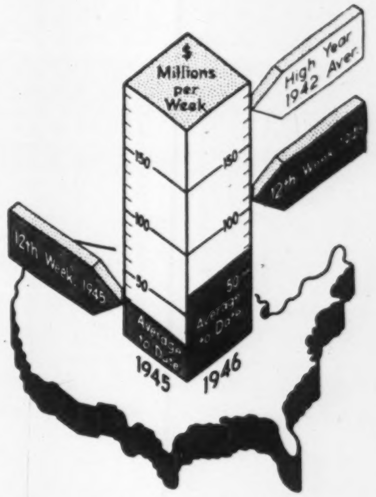
George William Bailey, Sr., 58, of Millburn, N. J., construction engineer, died March 8. During the recent war Mr. Bailey was project manager for the Wigton Abbott Corp. in the construction of the Bayonne Naval Supply Depot and the Navy aircraft delivery unit at Trenton, N. J.

Fred Williams Honens, 74, former engineer on the Illinois and Mississippi Canal in Illinois, and on the Missouri River project in the Kansas City area, died March 2. He was a graduate in civil engineering of the University of Illinois.

Arthur Louis Wilson, 54, resident engineer for the Hells Gate, B. C., project of the International Pacific Salmon Fisheries Commission, died Feb. 22. Graduated in engineering from McGill University, he served in the first world war with the Royal Canadian Engineers.

James D. McGann, 64, industrial and construction engineer for the International Harvester Co., died March 6 in Chicago. He was with the company 42 years.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Mar. 21 1946	Cumulative 1946 (12 wks.)	Cumulative 1945 (12 wks.)
Federal	$17,172	$96,485	$199,089
State & &Mun...	35,109	196,177	34,540
Total Public...	$52,281	$292,662	$233,629
Total Private..	53,650	552,709	109,277
U. S. Total...	$105,931	$845,371	$342,906

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Type of Work	Dollar Volume (Thousands) This Week	Cumulative 1946 (12 wks.)	Cumulative 1945 (12 wks.)
Waterworks ...	$14,819	$25,869	$8,463
Sewerage	1,826	9,668	7,624
Bridges	3,303	22,061	7,491
Highway	13,625	100,658	15,471
Earthwork, Waterways	14,742	59,193	6,878
Buildings, Public.	3,249	55,797	145,349
Industrial	14,906	226,380	78,825
Commercial ...	38,082	291,919	21,028
Unclassified	1,379	53,826	51,777

NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (12 wk.)	Cumulative 1945 (12 wk.)
NON-FEDERAL	$176,334	$167,894
Corporate Securities.	75,987	48,979
State and Municipal.	100,347	118,915
FEDERAL	158,320	77,137
Total Capital	$334,654	$245,031

ENR INDEX NUMBERS

Index Base = 100	1913	1926
Construction Cost	323.83	155.66
Building Cost	245.41	132.66
Volume	167	13

EDITORIALS

VOLUME 136 NUMBER 12

March 21, 1946

Oxygen For Sick Rivers

BUBBLING AIR into a flowing river at selected points as a means of reducing the effects of pollution was looked upon as a rather visionary scheme when it was first proposed some half dozen years ago. That the method has practical applications is now indicated from a series of tests conducted since 1943 on the Flambeau River in Wisconsin (see p. 76 this issue). Here sulphite paper wastes were causing serious conditions at a resort area 25 miles downstream from the source of pollution. An installation of aerators in the river, which supply as much as 1½ tons of dissolved oxygen daily, is shown to provide a definite accelerative action on recovery of the stream from effects of pollution; and in terms of stream flow, this supplemental aeration shortens the stretch of river involved by 8 miles. The investigators do not suggest this method as a panacea for stream pollution treatment, pointing out that their work is still in the experimental stage, and certain limitations are quite apparent. They do conclude, however, that pollution effects can be mitigated by river reaeration and state that such an installation promises advantages in low installed cost and operating expense. This technique offers new fields of study for the treatment of "sick" rivers.

Opportunities in Contracting

IN VIEW of the large and diversified programs of public and private construction that are projected there is little wonder that a large number of returning service men and others connected with the construction industry are exhibiting a strong interest in becoming contractors. But just how to get started as one is more complex than would appear at first glance. Not only is capital required, but equipment is very difficult to obtain. For example, to pre-qualify for bidding, liquid assets must be one- third of the estimated cost of the work, say about $17,000 on a $50,000 job, and to this would have to be added some $25,000 for the necessary tools and equipment. Then would be met the obstacle of obtaining the equipment since, due to the general shortage, manufacturers already have many unfilled orders on their books. Nor is government surplus easy to obtain, since it must be bought on a spot-cash basis. A far more secure approach would seem to be for an aspiring young contractor to enter the field through the "subcontractor" route; gather together a few men and secure enough equipment to subcontract small jobs until at least he can build up his plant and crew sufficiently to branch out on his own. Many present-day contractors started as subs, and there is no reason to doubt but that some of tomorrow's successful firms could not follow the same route.

Industry Our Best Weapon

IN SECURING CONTROL over the atom bomb, as is now the likely outcome of the controversy between military and civilian proponents of such control, the army is assuming far more responsibility than the mere guarding of a military secret. Even disregarding the responsibility for assuring the results of nuclear fission to peaceful pursuits, this is so because unless American knowledge in this field is continuously expanded we may find that we are guarding an obsolete weapon. And it is not the military, but civilian industry coupled with civilian science that advances our knowledge. It is on them that the military must depend for its new and improved weapons.

The Army Engineers have long acknowledged this fact, and no better statement on the subject has appeared than one recently made to the American Road Builders Association by the Chief of Engineers, Lt. Gen. Raymond A. Wheeler. "To the Corps of Engineers," said General Wheeler, "it appears tremendously important that we maintain close and productive teamwork with the American construction industry for we want always to be able to call upon the man and the special experience best qualified to build any particular type of project any new emergency calls for. We want to keep American roadbuilders strong and efficient for we know that the strength of American roadbuilders is a measure of the strength of America." The roadbuilding industry gave the army the bulldozer, the tankdozer and its airfield and roadbuilding techniques.

What General Wheeler says about the Engineers and the roadbuilding industry is true of the War Department and industry generally. It will be immeasurably more difficult, however, to maintain "productive teamwork" when secrecy and military control of the development of knowledge are dominant. And that is why the military responbility is so great, for science and industry are America's best weapons.

Yangtze Questions

RELEASE of preliminary sketches of the projected power and navigation project for the Yangtze River gorge in China (*ENR*, Feb. 28, vol. p. 310) adds a baffling new question to one that has puzzled engineers for some months. The new question relates to the reasons for planning such an enormous single project—equal to the combined capacities of Boulder, Grand Coulee and Shasta—when China's rehabilitation requirements would seem to be met more satisfactorily by many smaller power projects at the present stage of that country's economic development. Why, in any event, was it necessary for the U. S. Bureau of Reclamation to enter into a contract to do design work that could have been done by private engineering firms?

With respect to the justification of the project, no less an authority than Premier T. V. Soong stated within the past few days that China's immediate problem is rehabilitation, and that until that is done it would be folly to launch upon a large-scale program of economic reconstruction. In the light of this statement, it would seem either that the Chinese National Resources Commission was just daydreaming when it asked the bureau to design this vast scheme, or that it hoped that if the U. S. made the design it might thus morally commit itself to finance its construction. In either event neither the economic justification nor the practicability of the project is established.

Why a federal bureau should undertake the design is the other mystifying question. It could not have been because of lack of work for its design staff since the large U. S. reclamation program has caused the bureau to advertise for upwards of 2,500 additional engineers. It could not have been that no private engineering firms are available or competent enough to design the China project. Obviously there are several. And even if there were no others, J. L. Savage, retired chief designing engineer of the bureau and now consultant to the bureau on the project, could have found plenty of engineers willing to participate with him in such a venture.

In recent weeks new direction has come to the work in the persons of a new Secretary of the Interior and a new Commissioner of Reclamation. The questions that surround the Yangtze River project are important enough to justify their careful review. Nothing revealed to date explains why engineers of the bureau were placed in the anomalous position in which they stand today.

Too Much Emphasis on Law

THERE IS NO MAGIC in housing legislation that will produce a single house, and the sooner federal housing officials, the construction industry, real estate interests and Congress accept this fact the sooner can house building begin.

Federal officials could aid the cause by scaling down their extreme demand that unless every single item in their program is approved the housing goals will be doomed. There is nothing sacrosanct in such figures as 1,200,000 or 1,500,000 houses. The need is to get started on building as many houses as possible as quickly and economically as possible. The construction industry—materials manufacturers, engineers, architects, and contractors—would perform a useful function by controlling their jitters about the effect of housing controls on housing and of the housing program on other types of construction. The full capacity of the industry will be utilized in any event.

On their part, real estate interests could make a salutary contribution by tempering their opposition to ceiling prices on existing houses; their position is untenable anyway since they are fighting for something unrelated to the nation's need, which is the production of additional housing. In supplying this need there is assurance of plenty of healthy, profitable activity for real estate.

There are strong reasons to believe that the housing administrator, Wilson Wyatt, is a man of wisdom and vision, imbued with the desire to build houses and a realistic approach to the administration of controls. Since it is not the law but its administration that will cause houses to be built, quick compromises on the controversial points should be effected so the law can be passed.

ENGINEERING NEWS-RECORD

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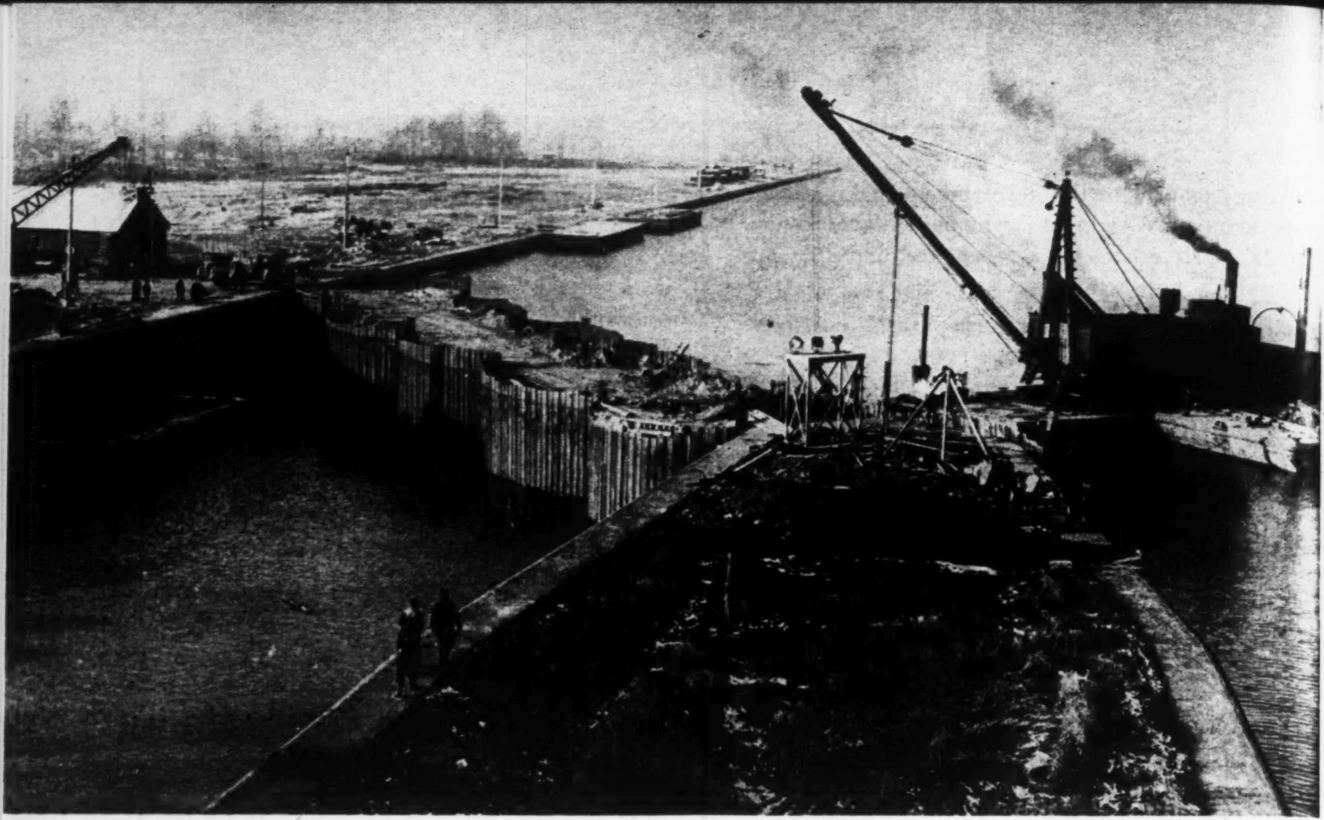

U. S. Army Engineer photos

Fig. 1. Unwatering the MacArthur Canal at the Soo required a five-cell cofferdam across the upstream entrance.

Sheetpile Cofferdam for a 30-ft. Head

Albert DiGiacinto

Senior Engineer, Spencer, White and Prentis, Inc.
New York, N. Y.

Contents in Brief—*U. S. Engineer construction at the Soo during the winter of 1944-45 required the installation of a steel sheetpile cellular cofferdam to resist a 30-ft. head of water. Although the cofferdam was founded on bedrock, a clay seal and ample berms resisted sliding and kept leakage to a minimum. A special clay seal was required between one end cell and the rock face of an existing canal wall.*

COFFERDAM CONSTRUCTION under an appreciable head of water invariably involves many uncertainties such as overturning, sliding, collapse of the cells or excessive leakage. Such problems were solved successfully during the winter of 1944-45 at Sault Ste. Marie, Mich., where it was necessary to dike off the upstream approach canal to the MacArthur Lock to install a concrete facing wall along the existing channel.

Since the general construction of this project has been described in a previous issue of *Engineering News-Record* (July 26, 1945, vol. p. 94) this article will deal only with the construction of the cofferdam and allied problems of unwatering the site.

Basically, the problem was to build 223 ft. of cellular sheetpile cofferdam completely across the canal between the south wall, known locally as the Southwest Pier, and the upstream nose of Bridge Island. The cofferdam rested on rock and was subjected to a 30-ft. hydrostatic head.

No downstream cofferdam was required as emergency gates as the locks downstream could be used. The waterway on the opposite side of Bridge Island was closed by a movable dam near the downstream end of the island (Fig. 2).

The design of the cofferdam consisted of five cells flanked by a single line of sheeting at each end to tie into the existing canal walls. Steel sheeting, varying from 31 to 40 ft. were set in a 5-ft. clay blanket deposited on the rock bottom of the canal by means of bottom dump scows. Cells were filled with run-of-bank sand trucked to the site and dumped directly into the cells. On the downstream side, a berm was placed by dumping directly from trucks which backed onto the completed cells.

At Bridge Island the connection to the cofferdam was made by running steel sheeting around the nose a distance of 30 ft. and filling a 3-ft. space left between the sheeting and rock with clay. A short run of sheeting was installed on the downstream side of the cofferdam at this location to assist structurally in making the transition from the No. 5 cell to the Island. A similar section was installed to make the connection between cell No. 1 and the Southwest Pier.

Also, at the Southwest Pier, it was necessary to run a single line of sheeting 50 ft. upstream to a joint between a rock-filled timber crib, which forms the canal face at that point. The sheeting then was run at right angles through the joint in the crib and into undisturbed earth behind the crib.

The main body of the cofferdam was designed by the U. S. Engineers in accordance with standard practice. A mathematical analysis of the design indicated a low but ample factor of safety for a temporary structure such as this. In view of the fact that the cofferdam was constructed on a 5-ft. blanket of clay to seal the fissures known to exist in the rock bottom because of submarine blasting, it would seem that the structure had little resistance to sliding. However, it must be remembered that the sheeting was driven through the clay to the rough rock bottom.

The head against the cofferdam was about 30 ft., although at times waves broke over the top of the sheeting which was 36 ft. above streambed. Cells No. 1 and 5 were circular with a diameter of 42 ft. 5 in. The other three were elongated, measuring 42 ft. 5 in. along the short axis, which was transverse to the line of the cofferdam, and 48 ft. 5 in. along the longitudinal axis. Diaphragms were built on a radius of 34 ft. while the sides of the cells were on a radius of 40 ft.

The steel sheeting was $\frac{3}{8}$ in. thick, 16 in. wide and weighed 23 lbs. per sq. ft. It was furnished by the Government who had salvaged it, in part, from material employed in the construction of MacArthur Lock.

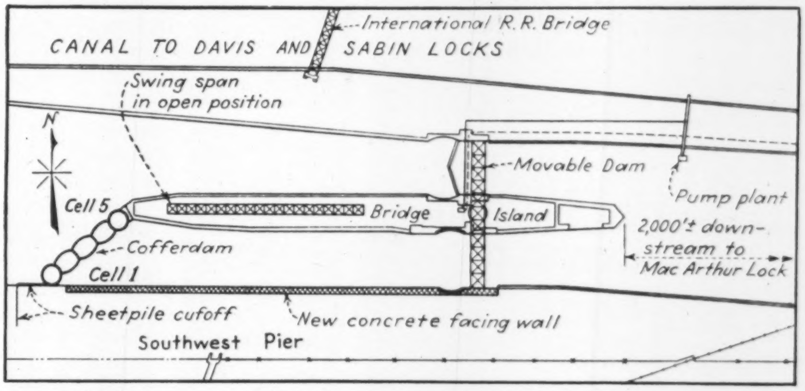
International R.R. Bridge
CANAL TO DAVIS AND SABIN LOCKS
Swing span in open position
N
Movable Dam
Pump plant
Cell 5
Bridge
Island
2,000'± down-stream to Mac Arthur Lock
Cofferdam
Cell 1
Sheetpile cutoff
New concrete facing wall
Southwest Pier

Fig. 2. Single lines of sheetpiles at each end of the cellular cofferdam were used for the connections to rock walls. At Bridge Island end, a clay seal was used.

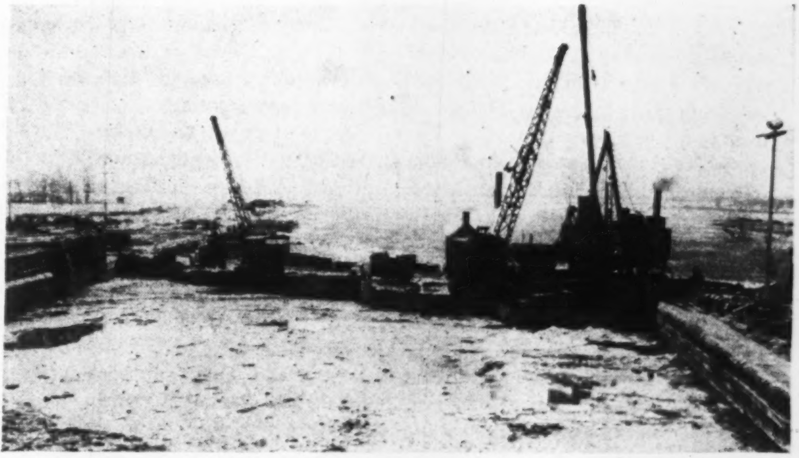

Fig. 3. Crawler-cranes removed the sand fill from within the cofferdam, following which the piling was pulled by a floating rig, shown at the far right. Note the new facing wall along the left bank.

Set to a floating template

Prior to Nov. 1, 1944, the date set for closing navigation in the channel to be blocked, all necessary preparations for building the cofferdam were made. Two floating templates were constructed on land and later slid into the water. They were built of 12 x 12-in. fir timbers with 3 x 12-in. outriggers to support the template edges. The template edges were made of two layers of 3 x 12-in. fir, cut to proper radius at a local mill and bolted to each other and to the outriggers. Two inches of clearance was provided between the template and the theoretical inside line of the sheeting to facilitate setting. The template assembly floated with about 6 in. of free board and in addition to acting as a guide and supporting the sheeting until a cell was closed and stabilized with fill, it served as an excellent working platform for the men.

Most of the secondhand sheeting had to be straightened. This was accomplished by running a crane over part of the sheet to be straightened, and pulling on the free end with the load line. To straighten the fittings, it was necessary to use heat which was furnished by acetylene torches.

Although not a difficult task, the splicing did require definite steps being taken to insure the production of satisfactory sheeting. It was found that the two pieces to be spliced had to be matched as to width, due to tolerances allowed in rolling. To be sure that interlocks lined up, a part sheet was threaded through them at each side before welding started.

A welding sequence also was developed to counteract the tendency for sheets to kink at the joint. Actually they were welded in four separate steps. After a double "V" had been cut on both of the ends to be spliced, the sheets were butted together, lined up and welded on one side to about one-half the depth of the "V." Sheets then were turned over and welded to one-half the depth of the "V" on the other side. The sheets were turned again to complete the weld on the first side started. Welding was completed by turning the sheet once more. The weld was carried across one side of the interlocks to help make the sheets watertight.

Except for the fact that the spliced sheets did not thread easily, the welded

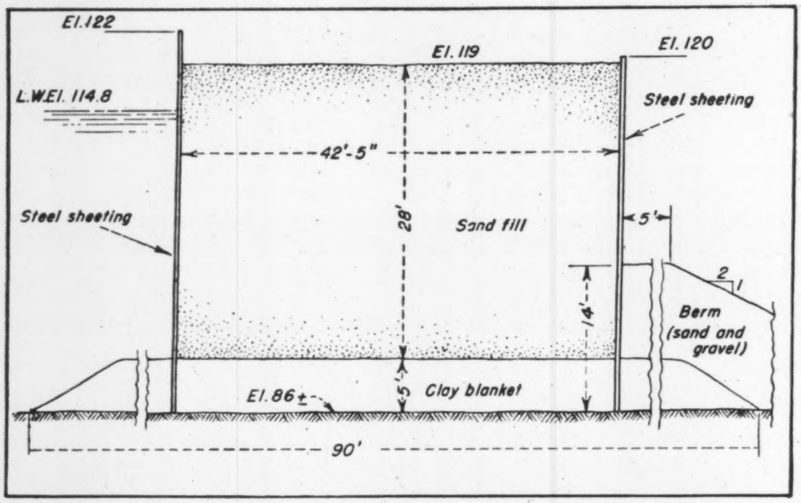

Fig. 4. A cross-section through the cells shows 5 ft. of clay blanket and 28 ft. of sand fill. An additional berm was placed on the downstream side for stability.

piling was just as good as new material. Not one of the piling or fittings spliced came apart either in driving or pulling.

Making the fill

Actual construction of the cofferdam started Nov. 1 with the dumping of the clay seal. The stiff, gray clay was excavated downstream of the Soo Locks from the channel of the St. Marys River by a floating crane and towed to the site in two 300-cu. yd. steel, bottom-dump scows. A tug maneuvered each scow into position in the cofferdam area designated by the engineers and held on to it while it was being dumped.

The clay was placed at the rate of two scow loads per day. Since the barges were 85 ft. long, it was possible, by placing them with their long axis parallel to the Southwest Pier, to cover the entire bottom of the channel in the cofferdam area with one scow length. It was decided to have a blanket 5 ft. deep to act as a watertight seal. Therefore, barges were dumped close enough to each other to bring this about; control being maintained by constant soundings. No rehandling or puddling of clay was required after dumping.

The first section of sheeting set was that along the Southwest Pier between the joint in the crib and cell No. 1. Next, the sheets in cell No. 1 between two Tees located adjacent to the Southwest Pier were set up using as a guide a template previously built and installed against the existing pier. These sheets were cabled back to the template and the pier to act as an abutment for the floating template built to form cell No. 1.

As soon as the floating template had been spotted in its proper position by means of a transit, it was cabled in place, and the setting of sheeting proceeded. This cell was set from land by a steam crane. Sheets were dropped without restraint after they had been guided for about 3 ft. into the interlock of the sheet already in place. In most cases the sheets cut through the clay and landed on the rock bottom. Great care was exercised to see that all sheets were properly interlocked as an improper interlock would mean the failure of the cell while it was being filled.

Closing the cells

Special care also was taken in making the closure of each cell. Failures of cellular cofferdams have been caused by forcing sheeting out of their interlocks due to driving the sheeting too hard in attempting to make a closure. In most cases the closure sheet was pulled into place by entering the interlocks and then pulling with the load line of the crane through a snatch block cabled to the top of the sheet.

After the sheet was down part way, if it was binding, the four or five piling adjacent to the closure sheet were picked up several feet in a group, by the crane, and dropped again. This had the effect of permitting the sheets adjacent to the closure piling to provide some slack. Driving was started as soon as a cell was completely set and closed. Very little driving was required since most of the sheets went through the clay and landed on the rock bottom. However, about four hours were spent on each cell to seat the sheets on the rock.

Due to passing of boats through the adjacent Poe lock, there generally was a current from west to east. This caused the cells to lean to the east an average of about 18 in.

Filling of the cell by direct truck dumping with sand began as soon as the piling had been driven to grade. The template was not removed until the fill had been carried to a depth of at least 10 ft. in order to insure the stability of the cell. Cables also were placed to hold the cell in shape as the sheeting had a tendency to deflect outward at the location at which the trucks were dumped due to the higher elevation of the fill at this point.

As soon as about 10 ft. of fill had been placed in cell No. 1, the template for cell No. 2 was floated into place and cabled in its proper location. Each cell built served as an abutment for anchoring the template of the adjacent cell. The floating template was fastened to the completed cell with ¾-in. cables, drawn tight with steamboat ratchets. A ¾-in. cable also was fastened from the northwest edge of the floating template to a mooring post on the Southwest Pier. Cells Nos. 2, 3, 4 and 5 were set and driven by a floating derrick. An average of two eight-hour shifts were required to set and close each cell.

Connection to Bridge Island

Sheeting for the connection to Bridge Island was set, driven, and bolted in place as soon as cell No. 5 had been driven to grade. To clear rock projections, the sheeting was set about 3 ft. from the concrete cap of Bridge Island. In order to prevent the bottom of the piling from kicking out due to the pressure produced by the clay fill placed in the 3-ft. space, a 21-ft. high sand and gravel berm was built on the outside of the sheeting. Bolts spaced 4 ft. apart, which had been previously grouted in the concrete cap just above water level, held the sheets at the top.

A 90-deg. corner and two straight sheets of piling were installed at the end of the run of sheeting which started at cell No. 5 and enveloped the nose of Bridge Island. This provided a relatively tight connection against the concrete and rock. To be sure that no material was lost at this connection, divers deposited clay filled bags in the area for the full depth of the piling. The 90-deg. corner and the two straight piles were held tight against Bridge Island by cables and turnbuckles.

The cofferdam was completed Nov. 22 at which time a differential head of 3 ft. on the structure was created by release of water through the lock system downstream. The full head was put on the cofferdam gradually over a period of five days. It was found after pumping down the water that the sand and gravel used to make the berm was on a slope practically identical to that shown on the plan. No maintenance was required on the berm throughout the life of the cofferdam.

Seepage through Bridge Island

Shortly after pumping down, the total inflow under and around the cofferdam was about 500 g.p.m. but a great deal of leakage occurred elsewhere. The principal source of infiltration into the cofferdam area was through two seams in the supposedly solid ledge rock that formed Bridge Island. While pumping down, a test was carried out which indicated that the inflow was 18,000 g.p.m. This greatly exceeded the volume anticipated and was beyond the 12,000 g.p.m. of installed pump capacity. To supplement the two 12-in. and one 16-in. electric centrifugal pumps originally planned, gasoline pumps were installed at a temporary location to handle the inflow until it was brought under control.

An attempt was made to caulk the seams from the dry side of Bridge Island by forcing wood wedges and oakum into the openings. This method was slow and only partially effective. It was abandoned in favor of working from the wet side when a test indicated that much better results could be obtained by dropping manure and cinders over the side so that the inflowing water carried the material into the seams.

In order to bring the manure and cinders close enough to the seams to be caught up by the inflowing water, canvas shields were hung over the sides of Bridge Island. Starting from the west end, canvases were hung along the island for a distance of 500 ft. The manure and cinders were carried into the seams by the water current gradually plugging the open spaces and choking off the inflow. In about two weeks the inflow was reduced so that the original pump installation was able to handle the remaining inflow.

The cofferdam was in place about 3½ months and performed very well the task for which it was designed. A sizable leak developed at the cutoff wall through the crib while excavating for the footing of the last monolith of the facing wall to be installed. This excavation increased the head on the cutoff wall about 5 ft., which evidently caused the leak as no other condition was changed. The leak was handled by redriving the sheeting at this location and by building a sandbag dike on the inside of the cofferdam to reduce the effective head about 5 ft.

Most of the sheets moved very little on redriving. However, one sheet went down about 3 ft., after which the leak subsided considerably. Further reduction of leakage through the cutoff wall was brought about by stock-ramming clay through 3-in. pipes placed against the sheets before backfilling.

Removal of the cofferdam was carried out in an order just the reverse to which it was built. The first step was to remove the connection around the nose of Bridge Island. This was done with a floating crane and a pile extractor. The sheets were laid on the cofferdam and dragged to the storage yard with a bulldozer where they were sorted and stacked. While this was being done, two crawler cranes working from the top of the cells started removing the berm on the downstream side of the cofferdam.

Little damage to piling

As soon as all berm material within reach of one crane had been removed, except for a 5-ft. berm left to support the sheets to be pulled, the rig started to remove the material in cell No. 5. After this material was removed to within 5 ft. of ledge rock, pulling of the sheeting in the cell was accomplished with the floating rig and pile extractor. The sheeting pulled very easily and in many cases the extractor was not required. In most instances the sheeting was as straight as when it was installed.

About 5 percent of the sheeting had a slight bend in the 5-ft. section embedded in the clay. The bottom of the sheets were unharmed even though driven to rock due to the fact that they were not overdriven when installed.

The same general procedure of excavating the fill from a cell and then pulling the sheeting was followed on the other four cells. Whenever the floating rig was not busy pulling sheeting, it helped excavate the fill from within the cells. This material was loaded on trucks and hauled to a spoil area.

The material which was left on the bottom to support the sheeting while it was being pulled, was removed by the floating rig equipped with a 1¼-cu. yd. heavy duty bucket. The material was loaded into two 300-cu. yd. bottom dump scows and transported by tug to a dump a few miles upstream. This equipment also removed the berm placed to support the sheeting used to make the connection to Bridge Island. The material within reach of land rigs along the Southwest Pier was loaded directly into trucks and hauled to a land dump.

As the work progressed, soundings were taken periodically to check on the removal of material. For a final check, before the channel was opened to navigation, on April 25, 1945, the entire area was traversed with a "Sweep." This device consisted of a timber float from which were suspended horizontally 1½-in. steel rods 20 ft. long. When the rods struck an obstruction, the impact was felt on the ¼-in. cables by which the rods were supported.

Survey points were set on both the inside and outside lines of sheeting and from time to time readings were taken and referred to a line established from Bridge Island to the Southwest Pier. The maximum movement, which occurred at cell No. 4 on the downstream side, amounted to 16 in. This movement occurred over the 3½-month period during which the cofferdam was in service and at no time was it the cause of any concern as to the safety of the structure.

Engineering personnel

The cofferdam was constructed by the Sunswick Corporation, a company associated with Spencer, White and Prentis, of New York City. It was part of a million-dollar contract with the U. S. Army Engineers under the supervision of Col. H. A. Montgomery, division engineer; Col. Allison Miller, district engineer; J. E. Harns, engineer in charge; and B. J. McCarthy, project engineer. For the contractor, Edward E. White was manager, the author superintendent of construction and George F. Flay, Jr., engineer.

Compact Tables for Manning's Formulas Simplify Hydraulic Computations

L. E. Holder
Engineer, U. S. Bureau of Reclamation

OF THE SEVERAL FORMULAS used by hydraulic engineers for determining velocity and quantity of flow in hydraulic structures, some are applicable only to flow in open channels, while others are applicable only to flow in pipes. The formulas published by Robert Manning in 1890 are applicable, however, to flow in both open channels and pipes when used with the proper constants and either r, the hydraulic radius for open channels, or d, the pipe diameter, for closed conduits. This, together with their comparative simplicity, accounts for the widespread use of the Manning formulas.

Condensed tables helpful

The accompanying tables present data from which exact solutions of these formulas, within the range of values usually encountered in the field, can readily be obtained. These tables supplement, but do not replace, the more complete and more voluminous tables published for the solution of Manning's formulas. Because of the compact arrangement and the ease with which they can be used, however, they should be of special value to field men, to engineering students and to engineers who are not specialists in hydraulic problems but want such information in compact form for occasional use.

Manning's formula for flow in open channels is expressed as:

$$v = \frac{1.486}{n} r^{2/3} s^{1/2} \qquad (1)$$

where v is the velocity in ft. per sec., r is the hydraulic radius in ft., n is the coefficient of roughness and s is the slope. Velocities for open channel flow are given in Table I for values of r from 0.1 ft. to 16.0 ft., when $n = 0.01$ and $s = 0.01$.

Similar in form to equation (1), Manning's formula for flow in pipes is

$$v = \frac{.590}{n} d^{2/3} s^{1/2} \qquad (2)$$

where d is the diameter of the pipe in ft., and v, n and s have the same significance as in formula (1). Since the diameter of the pipe determines the cross-sectional area of the water flowing in it, Table II includes columns giving both the velocity v, and the flow Q $(= Av)$.

A velocity or quantity from Table I or Table II when multiplied by the appropriate factor from Table III, gives the required solution for any combination of n and s.

Examples of use

Use of the tables can best be illustrated by the following examples:

Example 1—Obtain the mean velocity of water flowing in an open channel having a cross-sectional area of 90.8 sq. ft., $n = 0.025$, $r = 2.95$ and $s = 0.0004$.

From Table I, by interpolation, the velocity for this value of r is 30.56 ft. per sec., when $n = 0.01$ and $s = 0.01$.

TABLE I—FLOW IN OPEN CHANNELS BY MANNING FORMULA ($n = 0.01$ and $s = 0.01$)

r	v	r	v	r	v	r	v	r	v	r	v	r	v	r	v
0.1	3.20	2.1	24.36	4.1	38.07	6.1	49.62	8.1	59.93	10.1	69.43	12.1	78.33	14.1	86.72
0.2	5.08	2.2	25.13	4.2	38.68	6.2	50.15	8.2	60.42	10.2	69.89	12.2	78.76	14.2	87.14
0.3	6.66	2.3	25.89	4.3	39.29	6.3	50.69	8.3	60.91	10.3	70.35	12.3	79.19	14.3	87.56
0.4	8.07	2.4	26.63	4.4	39.90	6.4	51.22	8.4	61.40	10.4	70.81	12.4	79.60	14.4	87.96
0.5	9.36	2.5	27.37	4.5	40.51	6.5	51.76	8.5	61.89	10.5	71.25	12.5	80.04	14.5	88.36
0.6	10.56	2.6	28.10	4.6	41.10	6.6	52.29	8.6	62.38	10.6	71.70	12.6	80.47	14.6	88.77
0.7	11.71	2.7	28.81	4.7	41.70	6.7	52.81	8.7	62.86	10.7	72.16	12.7	80.88	14.7	89.18
0.8	12.81	2.8	29.53	4.8	42.29	6.8	53.33	8.8	63.33	10.8	72.61	12.8	81.31	14.8	89.58
0.9	13.85	2.9	30.22	4.9	42.87	6.9	53.85	8.9	63.82	10.9	73.05	12.9	81.73	14.9	89.98
1.0	14.85	3.0	30.91	5.0	43.45	7.0	54.37	9.0	64.30	11.0	73.50	13.0	82.16	15.0	90.38
1.1	15.83	3.1	31.59	5.1	44.03	7.1	54.89	9.1	64.78	11.1	73.94	13.1	82.58	15.1	90.78
1.2	16.78	3.2	32.28	5.2	44.60	7.2	55.41	9.2	65.25	11.2	74.39	13.2	82.99	15.2	91.18
1.3	17.70	3.3	32.94	5.3	45.17	7.3	55.92	9.3	65.71	11.3	74.84	13.3	83.42	15.3	91.58
1.4	18.59	3.4	33.59	5.4	45.74	7.4	56.42	9.4	66.19	11.4	75.27	13.4	83.84	15.4	91.98
1.5	19.47	3.5	34.25	5.5	46.30	7.5	56.94	9.5	66.66	11.5	75.71	13.5	84.26	15.5	92.38
1.6	20.33	3.6	34.91	5.6	46.87	7.6	57.45	9.6	67.12	11.6	76.14	13.6	84.67	15.6	92.77
1.7	21.16	3.7	35.54	5.7	47.42	7.7	57.94	9.7	67.58	11.7	76.59	13.7	85.07	15.7	93.17
1.8	21.99	3.8	36.18	5.8	47.97	7.8	58.44	9.8	68.06	11.8	77.02	13.8	85.49	15.8	93.57
1.9	22.80	3.9	36.82	5.9	48.52	7.9	58.95	9.9	68.52	11.9	77.45	13.9	85.91	15.9	93.96
2.0	23.58	4.0	37.45	6.0	49.07	8.0	59.44	10.0	68.98	12.0	77.88	14.0	86.32	16.0	94.36

Entering Table III at $n = 0.025$ and $s = 0.0004$, obtain a factor of 0.080. Multiply 30.56 by 0.080 to obtain a mean velocity of 2.44 ft. per sec. under the given conditions.

The flow, Q, is obtained by multiplying the area (90.8 sq. ft.) by the velocity (2.44 ft. per sec.), giving a value of 221.5 cfs. for this section.

Example 2—Determine the quantity of water that will be carried by a 24-in. concrete pipe laid on a slope of 0.001, if n is taken as 0.014.

From Table II, the flow in such a pipe is 29.41 cfs. when $n = 0.01$ and $s = 0.01$. Entering Table III at $n = 0.014$ and $s = 0.001$, obtain a factor of 0.226, which, multiplied by 29.41 gives a flow of 6.64 cfs. under the given conditions.

If the velocity of flow is desired, it is obtained in the same manner—by multiplying 9.36 ft. per sec. (from Table II) by 0.226, to obtain a velocity of 2.12 ft. per sec. under the same conditions.

Table III has been computed for all values of n from 0.008 to 0.060 and for all probable values of s. For slopes beyond the range of the table, the required factor is obtained by multiplying the factor for a slope of 0.01 by $10s^{\frac{1}{2}}$.

TABLE II—FLOW IN PIPES BY MANNING FORMULA ($n = 0.01$ and $s = 0.01$)

d	v	Q	d	v	Q	d	v	Q	d	v	Q	d	v	Q	d	v	Q
0′-1″	1.13	.006	2′-1″	9.61	32.76	4′-1″	15.06	197.29	6′-1″	19.65	571.13	8′-1″	23.76	1219.3	10′-1″	27.53	2198.4
2″	1.79	.039	2″	9.88	36.43	2″	15.29	208.56	2″	19.85	592.86	2″	23.94	1254.0	2″	27.70	2248.7
3″	2.34	.115	3″	10.13	40.28	3″	15.48	219.66	3″	20.02	614.20	3″	24.09	1287.8	3″	27.84	2297.2
4″	2.83	.247	4″	10.38	44.38	4″	15.68	231.28	4″	20.19	636.04	4″	24.24	1322.1	4″	27.98	2346.5
5″	3.29	.449	5″	10.63	48.76	5″	15.89	243.43	5″	20.38	659.04	5″	24.42	1358.7	5″	28.15	2399.0
6″	3.72	.730	6″	10.87	53.36	6″	16.08	255.67	6″	20.55	681.91	6″	24.57	1394.2	6″	28.29	2449.6
7″	4.12	1.101	7″	11.10	58.18	7″	16.27	268.46	7″	20.72	705.29	7″	24.73	1430.9	7″	28 44	2501.8
8″	4.50	1.571	8″	11.36	63.45	8″	16.48	281.81	8″	20.90	729.54	8″	24.90	1468.9	8″	28.59	2554.8
9″	4.87	2.152	9″	11.58	68.78	9″	16.67	295.39	9″	21.08	754.34	9″	25.05	1506.3	9″	28.74	2608.5
10″	5.22	2.847	10″	11.81	74.46	10″	16.86	309.38	10″	21.24	778.94	10″	25.21	1544.9	10″	28.89	2662.9
11″	5.58	3.683	11″	12.05	80.51	11″	17.07	324.16	11″	21.42	804.83	11″	25.38	1584.8	11″	29.03	2717.2
1′-0″	5.90	4.634	3′-0″	12.27	86.73	5′-0″	17.25	338.62	7′-0″	21.59	830.88	9′-0″	25.53	1624.2	11′-0″	29.18	2773.1
1″	6.21	5.724	1″	12.49	93.26	1″	17.43	353.65	1″	21.75	857.08	1″	25.68	1664.1	1″	29.33	2829.7
2″	6.54	6.991	2″	12.73	100.26	2″	17.64	369.91	2″	21.94	885.03	2″	25.85	1706.0	2″	29.48	2887.1
3″	6.84	8.393	3″	12.94	107.35	3″	17.82	385.80	3″	22.10	912.34	3″	26.00	1747.2	3″	29.62	2944.3
4″	7.14	9.967	4″	13.16	114.85	4″	18.00	402.12	4″	22.26	940.19	4″	26.15	1789.1	4″	29.76	3002.2
5″	7.45	11.74	5″	13 39	122.76	5″	18.21	419.56	5″	22.44	969.46	5″	26.31	1832.3	5″	29.91	3061.8
6″	7.73	13.66	6″	13.60	130.85	6″	18.38	436.71	6″	22.61	998.88	6″	26.47	1876.2	6″	30.06	3122.3
7″	8.01	15.77	7″	13.81	139.20	7″	18.56	454.35	7″	22.77	1028.42	7″	26.62	1920.1	7″	30.20	3182.4
8″	8.30	18.11	8″	14.04	148.26	8″	18.76	473.13	8″	22.94	1059.00	8″	26.78	1965.4	8″	30.35	3244.4
9″	8.57	20.61	9″	14.24	157.21	9″	18.94	491.87	9″	23.10	1089.70	9″	26.93	2010.6	9″	30.49	3306.2
10″	8.84	23.34	10″	14.44	166.64	10″	19.11	510.81	10″	23.26	1121.04	10″	27.08	2056.5	10″	30.64	3369.7
11″	9.12	26.31	11″	14.67	176.77	11″	19.31	530.83	11″	23.44	1153.80	11″	27.24	2103.9	11″	30.78	3433.0
2′-0″	9.36	29.41	4′-0″	14.87	186.92	6′-0″	19.48	550.70	8′-0″	23.60	1186.27	10′-0″	27.39	2151.2	12′-0″	30.92	3497.0

TABLE III—FLOW FACTORS FOR USE WITH MANNING FORMULAS

n \ s	.00005	.00010	.00015	.00020	.00025	.00030	.00035	.00040	.00045	.00050	.00055	.00060	.00065	.00070	.00075	.00080	.00085	.00090	.00095	.00100	.00125	.00150	.00175	.002	.003	.004	.005	.006	.008	.010
.008	.088	.125	.153	.177	.198	.216	.234	.250	.265	.280	.293	.306	.319	.331	.342	.353	.364	.375	.385	.395	.442	.484	.523	.559	.685	.790	.884	.969	1.118	1.250
.009	.078	.111	.136	.157	.175	.192	.208	.222	.235	.248	.260	.272	.283	.294	.304	.314	.324	.333	.342	.351	.392	.430	.464	.496	.608	.702	.785	.860	.992	1.110
.010	.071	.100	.122	.141	.158	.173	.187	.200	.212	.224	.234	.245	.255	.264	.274	.283	.291	.300	.308	.316	.354	.387	.418	.447	.548	.632	.707	.775	.894	1.000
.011	.064	.091	.111	.128	.144	.157	.170	.182	.193	.203	.213	.223	.232	.240	.249	.257	.265	.273	.280	.287	.321	.352	.380	.406	.498	.574	.643	.704	.813	.909
.012	.059	.083	.102	.118	.132	.144	.156	.167	.177	.186	.195	.204	.212	.220	.228	.236	.243	.250	.257	.263	.294	.323	.348	.372	.456	.526	.589	.646	.745	.833
.013	.054	.077	.094	.109	.122	.133	.144	.154	.163	.172	.180	.188	.196	.203	.211	.217	.224	.231	.237	.243	.272	.298	.322	.344	.421	.486	.543	.596	.689	.769
.014	.051	.071	.087	.101	.113	.124	.133	.143	.151	.160	.167	.175	.182	.189	.195	.202	.208	.214	.220	.226	.253	.276	.299	.319	.391	.451	.505	.553	.638	.714
.015	.047	.067	.082	.094	.105	.115	.125	.133	.141	.149	.156	.163	.170	.176	.183	.189	.194	.200	.206	.211	.236	.258	.279	.298	.366	.422	.472	.517	.596	.667
.016	.044	.062	.076	.088	.099	.108	.117	.125	.132	.140	.146	.153	.159	.165	.171	.177	.182	.188	.193	.198	.221	.242	.261	.279	.342	.395	.442	.484	.559	.625
.017	.041	.059	.072	.083	.093	.102	.110	.118	.125	.131	.138	.144	.150	.156	.161	.166	.171	.176	.181	.186	.208	.228	.246	.263	.322	.372	.416	.456	.526	.588
.018	.039	.055	.068	.078	.088	.096	.104	.111	.118	.125	.130	.136	.142	.147	.152	.157	.162	.166	.171	.175	.196	.215	.232	.248	.304	.351	.392	.430	.496	.555
020	.035	.050	.061	.071	.079	.087	.094	.100	.106	.112	.117	.122	.128	.132	.137	.141	.146	.150	.154	.158	.177	.194	.209	.224	.274	.316	.353	.388	.447	.500
.0225	.031	.044	.054	.063	.070	.077	.083	.089	.094	.099	.104	.109	.113	.117	.122	.126	.129	.133	.137	.140	.157	.172	.186	.198	.243	.281	.314	.344	.397	.444
.025	.028	.040	.049	.056	.063	.069	.075	.080	.085	.089	.094	.098	.102	.106	.109	.113	.117	.120	.123	.126	.141	.155	.167	.179	.219	.253	.283	.310	.358	.400
.0275	.026	.036	.044	.051	.057	.063	.068	.073	.077	.081	.085	.089	.093	.096	.100	.103	.106	.109	.112	.115	.129	.141	.152	.163	.199	.230	.257	.282	.325	.364
.030	.023	.033	.041	.047	.053	.058	.062	.067	071	.074	.078	.082	.085	.088	.091	.094	.097	.100	.103	.105	.118	.129	.139	.149	.182	.210	.235	.258	.298	.333
.035	.020	.029	.035	.040	.045	.049	.054	.057	.061	.064	.067	.070	.073	.076	.078	.081	.083	.086	.088	.090	.101	.111	.120	.128	.157	.181	.202	.222	.256	.286
.040	.018	.025	.031	.035	.040	.043	.047	.050	.053	.056	.059	.061	.064	.066	.068	.071	.073	.075	.077	.079	.088	.097	.105	.112	.137	.158	.177	.194	.224	.250
.050	.014	.020	.024	.028	.032	.035	.037	.040	.042	.045	.047	.049	.051	.053	.055	.056	.058	.060	.062	.063	.071	.077	.084	.089	.110	.126	.141	.155	.179	.200
.060	.012	.017	.020	.024	.026	.029	.031	.033	.035	.037	.039	.041	.043	.044	.046	.047	.049	.050	.051	.053	.059	.065	.070	.075	.092	.103	.118	.129	.149	.167

Canal Lined With Stabilized Earth

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***Contents in Brief**—To determine practicability of lining irrigation canals with stabilized earth, the U. S. Bureau of Reclamation lined sections of a canal at the Altus project in Oklahoma with soils treated to increase their resistance to erosion and to reduce their permeability. Methods used to compact the soils were similar to those used for soil compaction in highway and airport work.*

SECTIONS of the main canal of the Altus Project in Oklahoma have been lined with stabilized earth to determine whether soils can be processed to form a satisfactory canal lining. Portland cement and a resin compound were used as the stabilizing agent, being used separately and in combination in different test sections. Engineers of the Bureau of Reclamation who conducted the tests believe that this is the first time that these two materials have been used in this way.

The purpose of the work was to obtain a low cost, relatively impermeable, stabilized earth lining which could be adapted to present day construction machinery and methods. This type of lining, if found successful, would be especially adaptable as well as economical in sandy or sandy loam soils where seepage losses would be high and costly, and possibly detrimental to nearby lands, but where the overall cost and the necessity for impermeability would not justify the expense of concrete lining. It was with this theory in mind that the experimental work was carried out.

Various linings tried

A 500-ft. length of the canal was selected in which the soil was stabilized by using cement or the resin compound in varying percentages, and by using a combination of the two. The soil mixtures were placed in 4 and 6-in. layers. The cement content used in the standard soil-cement mixture was 11 percent by volume, but was increased to 16 percent for the small section of plastic soil-cement mix. The resin was mixed with earth in percentages of 1½ and 2½ and placed in the same manner as the soil-cement mixture. A mixture of 1½ percent of resin and 6 percent cement was tried on a 25-ft. section of the canal slope. In all cases the soil used consisted of the sandy loam excavated from the canal section.

The resin compound used in these tests was Stabinol, which was placed on the market in 1944 by the Hercules Powder Co., (*ENR* March 16, 1944, vol. p. 385).

The method of constructing the lining is illustrated by the accompanying photographs. After the soil and cement (or resin) had been mixed in a 2-cu. yd. mixer near the job it was dumped at the top of the slope by an end-dump truck. Spreading of the material was by a bulldozer.

A sheepsfoot roller, pulled up and

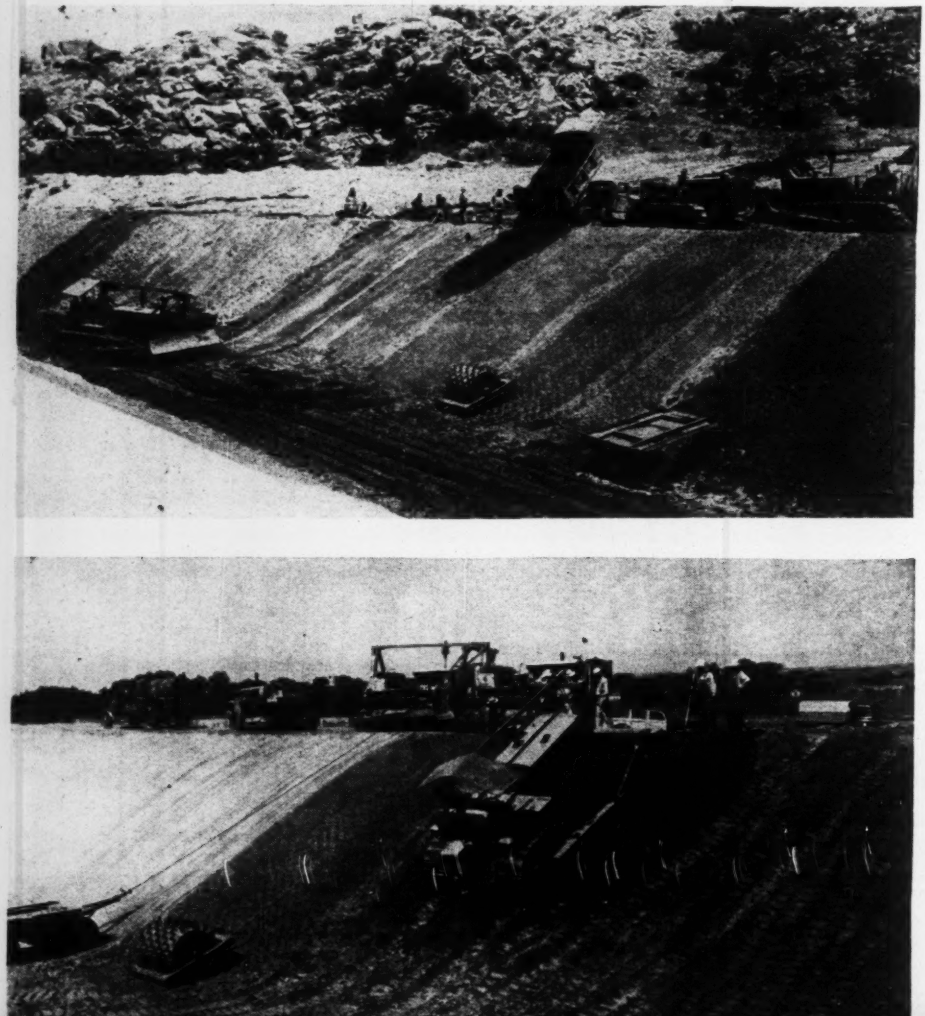

Fig. 1. The general procedure in paving the slopes was to spread the stabilized earth mixture with a bulldozer and to compact it with sheepsfoot and pneumatic-tired rollers.

down the slope by means of a winch on the rear end of a tractor, was used in the first operation to compact the lining. Final rolling was by means of a pneumatic-tired unit pulled by still another tractor using a snatch block attached to a dead end.

An exception to the methods just described was construction of the short section of plastic soil-cement lining. The soil, cement, and water were mixed in the same 2-cu.yd. mixer at about a 6-in. slump instead of at optimum moisture content, as is the case with standard soil-cement mix, and delivered to the slope of the canal in a concrete bucket handled by a crane (Fig. 3). Workmen using a screed and hand floats spread the material, which requires no additional compaction.

The completed lining on the slope and the successive stages of placing the lining in the canal bottom are shown by Fig. 2. The method used in lining the canal bottom was similar to normal stabilizing methods on highway and airport work. To avoid confusion in studying Fig. 2, it should be noted that the completed soil-cement lining has been covered with a 1-in. earth blanket for curing, while the resin mix has no covering.

Need for special equipment indicated

Since the amount of lining was so small and strictly on an experimental basis, representative cost data are not available. The experiment was carried out with equipment on hand on the project, and the prime purpose of the experiment being to construct a lining of the best possible quality rather than attempting to develop methods or special equipment at this time. But it has been concluded that if this type of lining proves successful from the standpoint of durability, special equipment will need to be developed to eliminate the awkwardness of working on the slope of the canal bank. Such a development will be necessary to place the cost of installing this type of lining on a competitive basis with more costly linings, such as concrete.

The canal has been operating with

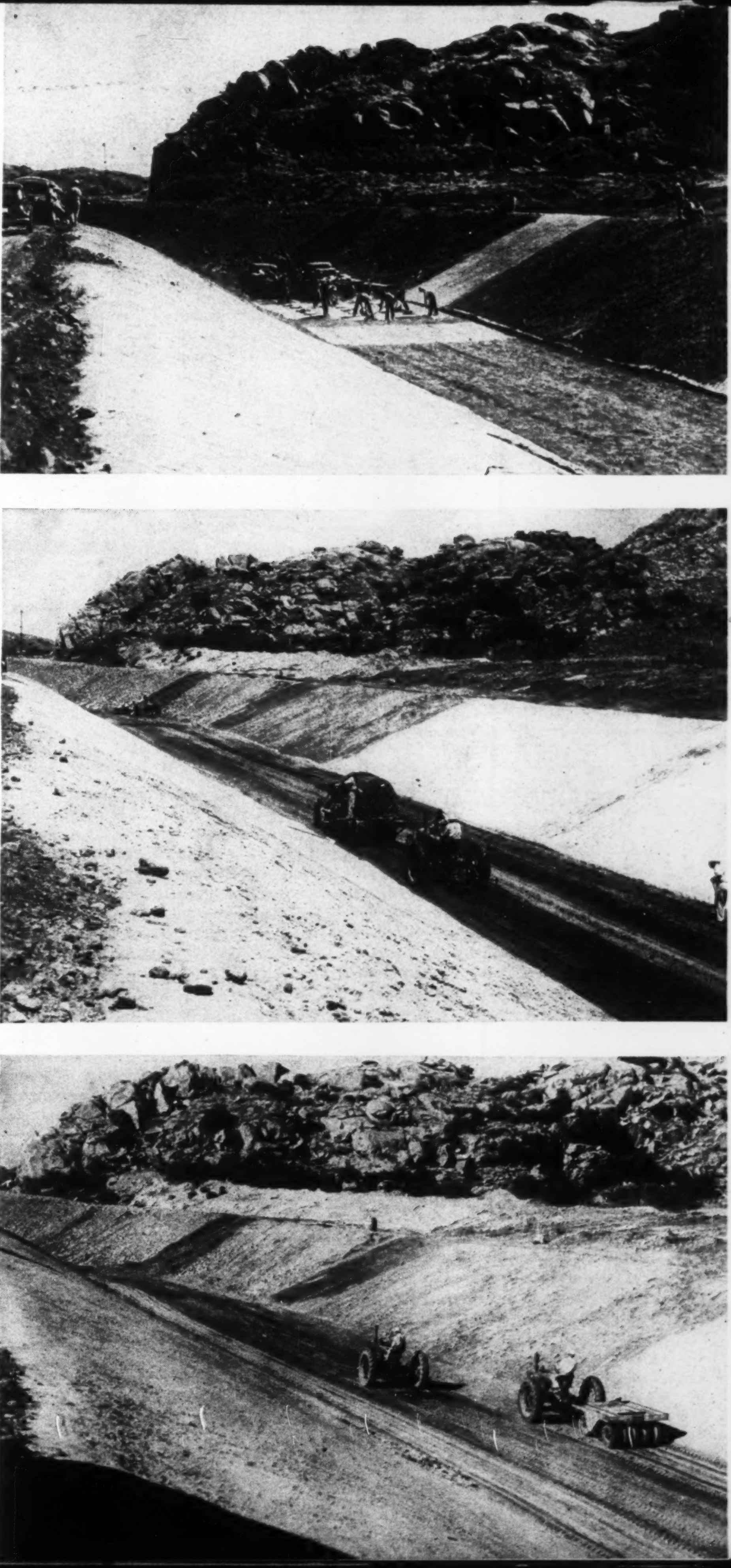

Fig. 2. In lining the bottom of the canal the stabilizing materials were delivered in bags and spread on the surface with hand tools as shown at the top. Mixing and compaction was by methods common to soil-cement paving operations on airport and highway work.

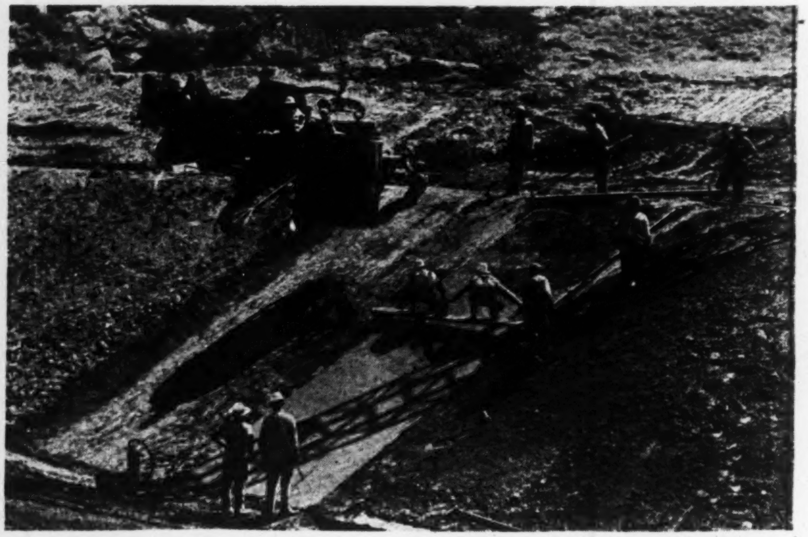

Fig. 3. A plastic soil-cement mix at about 6-in. slump was placed on one of the test sections in the same manner as concrete, using forms and hand tools to produce a lining of uniform thickness. No compaction is required with this type lining.

a water depth of approximately 6 ft. since Sept. 11,1945, and to date no serious damage has been noted on any section of the lining. However, it will be necessary to observe the reaction of the test lining through several operating seasons before any prediction can be made as to its durability as compared with other types of canal linings.

All construction work on the Altus Project is being carried on by the Bureau of Reclamation forces under the general supervision of Michael W. Straus, commissioner, and Walker R. Young, chief engineer. Wesley R. Nelson is regional director with headquarters in Amarillo, Texas, and H. E. Robbins is construction engineer with headquarters on the project.

The experimental construction was directed by the writer and K. L. Powers, materials engineer. The success of the work was greatly enhanced by the help of V. O. Peterson of the soil-cement bureau of the Portland Cement Association, P. J. Reno of the Hercules Powder Co., and W. G. Holtz of the Bureau of Reclamation's earth materials laboratory in Denver. M. D. Catton, manager of the soil-cement bureau, and R. F. Blanks, chief, engineering and geological control and research division of the Bureau of Reclamation, also contributed valuable suggestions.

Causes of Masonry Stains Found

A report on stains in stonework, prepared by the Brickwork and Masonry Sectional Committee of the Institution of Structural Engineers, which was published in the *Journal* of the Royal Institute of British Architects, December, 1945, contains the following conclusions and recommendations:

The aqueous extract from stone taken from a building was found to contain organic material natural to the stone, organic material derived from soot, finely divided free carbon from soot and other staining materials.

There is a substance contained in many natural limestones, and in some sandstones, that stains the stone a light brown color without introduction of extraneous staining material; in other words, the stone is self-staining. The stain becomes darker in the presence of alkaline substances such as lime and soda.

This staining substance in stone is soluble in water and in organic solvents. In accordance with the movement of the water in which the staining material is dissolved, stains may disappear from one place and then appear in another, moving in general to those parts of the stone where evaporation is greatest.

Stone of adequate thickness should be used. The present-day tendency to reduce the thickness of stone facings accentuates the liability to staining from backing or from steelwork, unless the stone is properly protected. For example, foreign matter left behind stone facing is liable to cause stains. A bituminous or other suitable backing may be used on all sides of stone blocks except the face. Care must, however, be taken with the pointing, since moisture may creep either through the mortar or over its surface.

Porous mortars will absorb staining material from the stone. In experiments carried out for the investigation, it was found that in nearly all cases where a weak porous mortar was used, stains and efflorescence formed on the mortar. This may be an advantage, for if the efflorescence causes surface disintegration, it will be easier to replace the mortar than the blocks of stone.

Iron compounds frequently act as staining material. Water containing carbon dioxide in solution will dissolve rust to form a clear solution, which is capable of traveling through stone and producing strong iron stains several inches away from the point of contact with the rust. Iron stains may also originate from compounds of iron in building sand used in mortar.

Unsightly stains are frequently produced by surface washings from metal or timber, and stains caused by fumes have been noticed on exterior walls.

Artificial stone made with porous aggregates stains more readily than those made with non-porous aggregates. The use of sand with cement for bedding this type of stone, though a very common practice, is not advisable. It is preferable to bed both artificial and natural stone with a very fine mortar or putty made with stone dust (obtained from the same or similar stone) and lime or cement.

That certain large stone-faced buildings are being regularly cleaned with plain water is regarded as an important advance in present-day practice for the preservation of the stone. The work of cleaning may be expensive, but it is considered that the cost is fully justified. The work should be properly supervised; only clean water, cold or hot (as in steam cleaning) should be used. The use of chemicals and steel wire brushes should not be permitted.

Denmark in the World of Engineering

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Editor's Note—*With a population of barely 4 million, Denmark naturally has few engineers. But these few have made important contributions to the advancement of the engineering art and construction practice throughout the world. Now that Denmark is once again free from the tyranny of the Germans after five years of occupation, her engineers seek to make their contribution to rebuilding the world. Mr. Andrup tells of these aspirations, and presents convincing examples of past performance to indicate why the Danish engineer expects their fullest realization in the postwar world.*

DANISH ENGINEERS are eager to participate in the reconstruction of a new world, which can be built on the basis of confidence and cooperation. Although only relatively few in number, their record of past performance, both at home and abroad, is one of considerable accomplishment. Consequently, the writer was particularly gratified when the editor of *Engineering News-Record* asked him to prepare a brief account of conditions in Denmark and the outlook for the future.

First let me say that Danish civil engineers are not unfamiliar with the United States and the manner of doing things in this country. More than ten percent of Danish engineers have at one time or another worked in the United States and, except during the war when they were unobtainable, American engineering journals received closest scrutiny in this country.

We recall with pride that prior to the war, five of our engineers were serving as professors in American universities, not the least of whom is H. M. Westergaard, dean of the Graduate School of Engineering, Harvard University. Among the contractors we think of F. Lichtenberg, who participated in the building of Rockefeller Center. And finally we remember that Lt. Gen. S. Knudsen, whose efforts so greatly expedited U. S. war production, was a Dane.

Wartime conditions

Prior to the war, considerable attention was given to the construction of bridges over the waterways that sever Denmark. Notable among these was the Lillebaelt bridge and the Storstroem crossing; the latter, which is 2.3 miles in length, is the longest bridge in northern Europe.

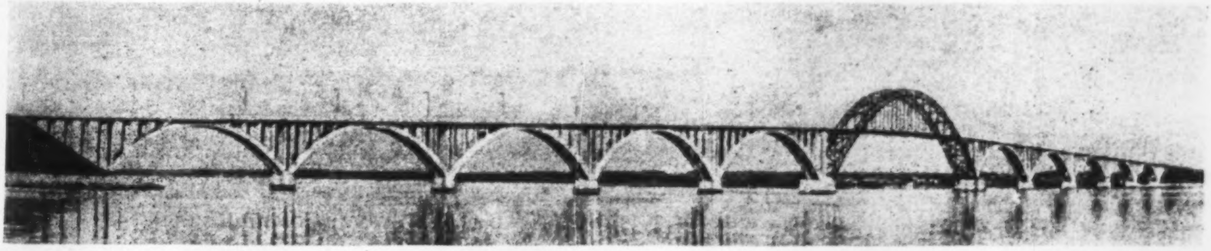
Mention should also be given to the Queen Alexandrine Bridge, which was completed in 1943 despite great difficulties. This structure spans the 4,820-ft. wide sound between Seeland and Moen; the central portion is a 2,440-ft. high level structure consisting of a long steel arch joined at either end by five reinforced concrete spans.

Following the German occupation in April, 1940, the situation in Denmark was extremely difficult. Through the allocation of import licenses for new materials, the Germans exercised heavy pressure on industry, which provides one of the major sources of employment in Denmark. For each allocation the Germans demanded services and work, and if these were refused, the factories had no alternative but to close down.

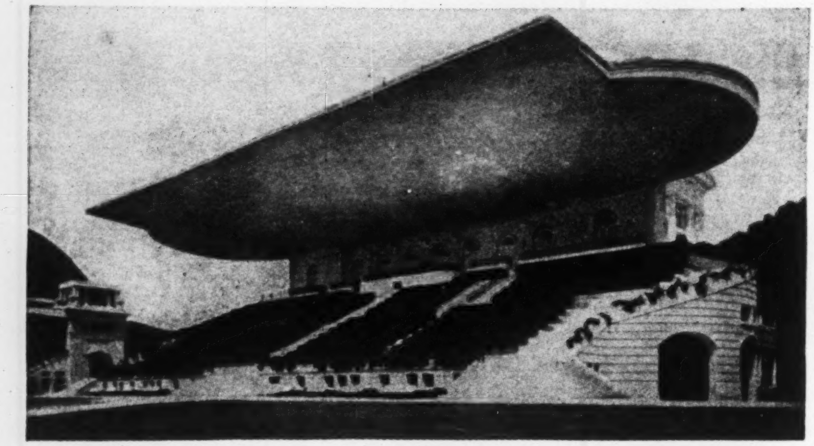
Under these circumstances it became a necessity for the Danish government to create new kinds of work (such as housing and public works) by special legislation in order to counteract unemployment. Meantime, Danish industry sought to obstruct, to the extent it was possible, the manufacture of goods intended for Germany without running the risk of being deprived of raw materials.

The latter was solved instinctively, so-to-speak, by the government and by the Danish engineers. It sounds like a paradox, but the most important part of the work allotted to the engineers was, in fact, to delay and render difficult the work they had in hand. Red tape, faulty correspondence, misunderstandings, etc., proved to be excellent weapons in the struggle for cutting down the output, and they were extensively used. Many engineers had also joined the underground movement and directed the sabotage and blowing up of factories, where the owners had consented to work for the enemy.

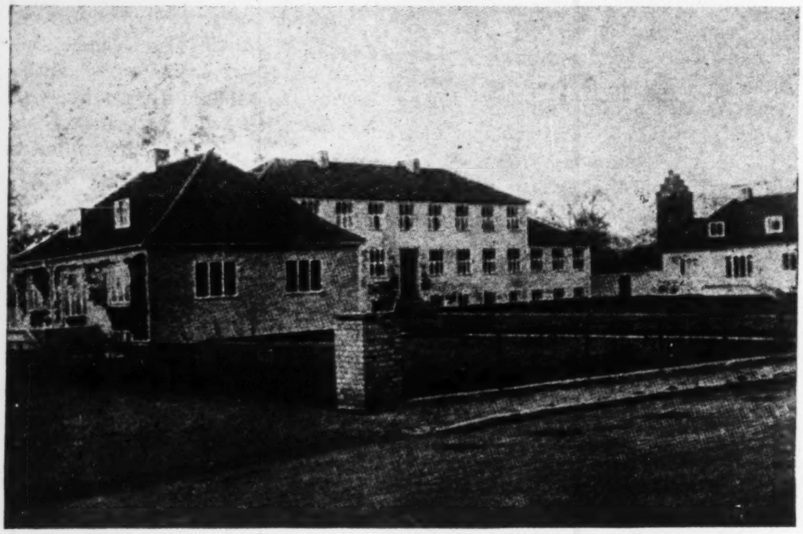
Despite these adverse conditions there were places where work was



Queen Alexandrine bridge in Denmark spans the 4,820-ft. sound between Seeland and Moen. The central span is a 2,440-ft. steel arch, and it is joined at either end by five reinforced concrete spans.



Grandstand at the Rio de Janeiro racetrack with a 75.5-ft. cantilevered roof is one of the structures in South America that is said to owe its origin to the inventiveness and enterprise of Danish engineers.



School buildings constructed in Denmark during the war. This project was one of the few that the German occupation forces permitted to be undertaken.

done, severely and unswervingly, namely at the technical schools and at the Royal Technical College in Copenhagen. Technical education and scientific research work are closely harmonized here. Consequently a well-trained and competent staff of young engineers are now prepared to go out in the world and lend their assistance to building up all that which has been devastated by the war.

It seems opportune to remark at this point that Denmark has always placed the highest values on scientific education, and as far back as 1829 "The Technical Institution of Denmark" was founded in Copenhagen by Hans Christian Oersted, discoverer of electro-magnetism.

A number of able engineers have in the course of years been graduated from this school, and their accomplishments have by no means been restricted to the mother country. In fact there is probably no country in the world where Danish engineers' work has not been undertaken.

Activity in foreign lands

Structural engineers and contractors in particular have won a name for Denmark in foreign countries. Quite apart from their construction achievements, they have distinguished themselves by inventing new design types and have thus garnered international professional distinction.

Any review of some of those works abroad should include the following:

England—In England the Danes have been particularly active in building harbor works, as for example those at Purfleet, Hamble, and Fawley. Bridges and factories, too, have been undertaken, and it was a Danish engineer who completed the new Waterloo Bridge in London under the stress of blitzes and bombings.

France—There has been published in *Engineering News-Record* (May 31, 1945, vol. p. 758) an interesting article on the repairs of the Cherbourg port, where the piers and the railroad station were designed and built by a Danish firm in 1928-30. The drydock at St. Nazaire for the *S. S. Normandie* was built in 1924-32, and Castelmorin bridge in 1932-33 as well as many other bridges.

Holland—Quay walls to the length of 856 ft. have been built at Delft and a silo holding 495,000 cu. ft. at Spijck. But by far the most important engineering work was the tunnel under the Maas near Rotterdam, commenced immediately before the war and completed in 1941 despite enormous difficulties.

A Danish firm submitted the proposal for a square tunnel and work was started on the project in 1938. Total length of the tunnel including the approaches is 3,520 ft., and the under-river portion is 1,837 ft. long. The latter was built in nine sections, each 203.4 ft. long, 81 ft. wide and 22 ft. high, and these sections were floated into place and sunk to precise position.

When the war reached Holland three tunnel sections had been already sunk and the others were in course of construction. When the fight over Rotterdam reached its climax a catastrophe was pending, as the semi-finished sections required constant pumping in order to float, and only a prompt and courageous action in the midst of the fighting prevented a disaster.

After a quiet inauguration the tunnel was opened for public traffic in 1941. Total expenditure was about $11,000,000. The technical achievement, represented by this work, in normal times would have been loudly acclaimed all over the world. (Details were published in issue of Mar. 7, vol. p. 336. Preliminary work on the project was described in *ENR* Nov. 7, 1940, vol. p. 608.—*Editor*)

Poland—Gdynia, the only port of

Poland was also built by Danish engineers. Waterpower plants and highway construction with out-of-level crossings and bridges have also been executed in Poland, as well as in Esthonia, Latvia and Lithuania.

Portugal—A number of harbor works have been performed in this country, notably those at Setubal and Funchal.

Iceland—In Iceland waterpower plants at Ljcsafoss and Laxaa were completed immediately before the war, but by far the most interesting enterprise was the construction of the long-distance heating system from hot springs for the town of Reykjavik. The hot water is carried through a 9-mile pipeline to Reykjavik and there distributed to the heating plants of the individual houses. This work, unmatched in its special features, was commenced in 1939 and completed in 1943, and saves for Iceland coal imports to the amount of 40,000 tons annually.

South America—In Brazil power stations have been built in Alberto Torres at Ituere, Rio Pomta and Rio Tagnarassu, and in 1939 at Montevideo, Uruguay. The grandstand at the Rio de Janeiro track should be pointed out as a particularly fine example of a reinforced concrete structure. Also the football stadium and a large number of commercial buildings in Rio de Janeiro owe their origin to the enterprise of Danish engineers.

Among remarkable bridge structures in the country there should be mentioned the 1,181-ft. railroad bridge over the Macacú River at Cabo-Frio, a 2,526-ft. combined roadway and railroad bridge crossing the Rio Doce, and a 531-ft. arched-span bridge over the Mogy-Guassú River.

In Argentine can be seen a number of important works including the sewage disposal system in Buenos Aires, a large silo plant in Balna Blanca having a capacity of 80,000 tons and other silos with a total capacity of 400,000 tons.

In Uruguay and Venezuela Danish engineers have also been active, as well as in Mexico, where the 6,888-ft. pier at Progreso was completed in 1941.

And in South Africa, Siam, India, Australia and New Zealand many enterprises of miscellaneous character bear witness to the activity of Danish engineers.

Near East—In Turkey Danish engineers have built railroad lines to an amount of 55 million gold dollars, and even before these projects were finished a contract was concluded with the Iranian government under which 651 mile of railroad lines were to be constructed through an exceedingly difficult terrain.

The contract sum for the latter was as high as $115,500,000, and, the following particulars may perhaps convey an idea of the magnitude of this enterprise which in the busiest periods gave work to nearly 55,000 men. About 26 million cubic yards of earth were blown up or excavated, and 3,800 tons of dynamite were used. The number of long bridges designed and built was 251 and the number of short bridges no less than 4,000. The line ran through 245 tunnels, with a total length of 50 miles; some 64 stations were built, including the main depot in Teheran. It was over this rail line that the United States Army transported large volumes of supplies to Russia during the war.

Great silos were also constructed in Iran, for example, the one at Teheran with a capacity of 65,000 tons. The works were continued in 1939-40 in which period a 31 mile railroad line from Teheran to Tabriz was completed, and the execution of another line 27 mile long, running through a rather unapproachable country, was put in hand in 1940, the contract sum being $9,450,000.

For a brighter future

The enumeration of these activities has been made with the sole purpose of throwing some light on the capability and experience of the Danish engineers and contractors in foreign lands. Both at home and abroad they have been energetic and ingenious in the execution of works that aid in the betterment of living.

In this respect the engineers of Denmark have sought to add their contribution to the goal that is the common objective of engineers throughout the world. They hope and expect to utilize their skills in the reconstruction of a better world for the future.

Many States Are Now Assisting Local Planning Efforts

State aid to local planning necessitated during the war by the shortage of planning personnel has become one of the most important activities of a number of state planning agencies, including those of Tennessee, Alabama, Wisconsin, Virginia, Rhode Island, Michigan and New York.

According to a report of the American Society of Planning Officials, state participation in local public works and economic development programs is a strong present trend. The states which have provided direct financial assistance to local public works programs are New York, Michigan, California, New Jersey, Maryland, Illinois and Pennsylvania. Many other states such as Arkansas, Georgia and Louisiana, give staff assistance to the preparation of city and county capital improvement programs.

Every state has set up some kind of agency to devise solutions for one or more of the many reconversion planning problems. The society reports 74 post war state organizations in planning and development work. Of this number 28 are established planning boards or commissions or more recent creations in the same pattern. The rest are agricultural, economic, resources, development, and other agencies, some of them planning divisions.

Two-thirds of California's planning budget goes to its community development programs, primarily for the purpose of creating new jobs. In New Jersey, the Department of Economic Development is working for the establishment in every community of a special development commission. Kansas emphasizes industrial promotion and advertising. The Missouri Department of Resources and Development sponsored county committees to make a detailed study of employment needs in the state. New York, Pennsylvania, Massachusetts, and New Hampshire have for years provided business and industries with accurate information on economic trends, while continuing the larger program of comprehensive planning.

Aerating a River to Reduce Pollution

***Contents in Brief**—Building up the oxygen supply in a polluted stream by mechanical diffusion of air provides a new approach to pollution abatement measures. This is the conclusion based on two years of full-scale experimentation on a stretch of the Flambeau River in Wisconsin, where sulphite paper wastes were causing serious conditions at a resort area some 25 miles downstream from the source of pollution. Data obtained show that efficient application of the method is limited to streams wherein the oxygen content falls below 4 pmm., but in all cases it serves to speed stream recovery. With flows of 1,000 cfs. it was found possible to add as much as 1½ tons of oxygen daily.*

BASIC INFORMATION and data gathered during full-scale experiments conducted on the Flambeau River at Park Falls, Wis., show that mechanical reaeration of streams may be considered a new method of reducing pollution. In effect, the process simply accelerates by means of diffused air the normal biological rates of activity naturally occurring in rivers and streams. When compared with processes involving treatment of waste liquors prior to their discharge, the river reaeration scheme is said to promise advantages in low installed cost and operating expense.

The results of the experiments are contained in a report on the project released to the pulp and paper industry by its National Council for Stream Improvement.

Definitely considered to be still in the experimental stage, however, the process has certain limitations that should be recognized where application of reaeration is to be considered. The term "reaeration," assigned to the process by the patent holder, Prof. R. G. Tyler of the University of Washington, in itself delineates one limiting condition. Streams receiving waste only can be aerated efficiently and practically if the ratio of biological oxygen demand (B.O.D.) to volume of stream flow is such that the dissolved oxygen content of the receiving waters falls below a certain maximum value, now thought to be around 4 ppm.

Above this maximum dissolved oxygen level, the efficiency of absorption of oxygen in water falls off rapidly, especially at temperature above 20 deg. C. Conditions for possible reaeration application are said to be so varied that it is difficult to delineate minimum loading for maximum efficiency. Results to date, however, would seem to indicate that with sulphite waste liquor a minimum 5-day (B.O.D.) loading of between 1,000 and 5,000 lb. per 100 cfs. of stream flow is required if reasonable efficiency is to be expected.

Another condition to the application of reaeration principles is concerned with the time required for microbiological action to take place. In flowing streams that exhibit a considerable demand for oxygen this time factor extends over a considerable distance and is dependent on many variables. Principal advantages of reaeration of polluted streams lies in decreasing the length of stream involved in the active stage of microbiological oxidation and in maintaining dissolved oxygen levels above a safe minimum for the requirements of fish and other normal stream life.

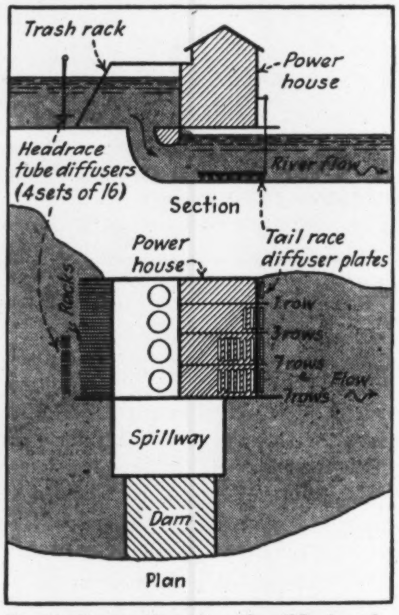


Fig. 1. Reaeration by air diffusion in headrace and tailrace of power plant accelerates river recovery from the effect of sulphite paper waste pollution in Wisconsin.

Flow regulation alone not adequate

Pollution of the Flambeau River by sulphite waste liquor from the Flambeau Paper Co. at Park Falls has been a problem for more than ten years, with years of low stream flow causing serious conditions affecting the river in a resort area some 25 to 30 mi. from the source of pollution.

In an attempt to remedy these conditions, stream surveys initiated by the Wisconsin State Board of Health served as a basis for investigating various methods of treating the sulphite waste liquor. Ponding was studied extensively; but experience elsewhere with seepage and odor nuisances, combined with the lack of a suitable location for a lagoon, weighed against this method.

Stream-flow regulation from upstream power company reservoirs was then tried, and has been practiced since 1942. Regulation of flows to give a minimum of 700 cfs. during critical periods has been of considerable value, but critical conditions of low dissolved oxygen have prevailed in spite of flow regulation and it was early recognized that regulation alone was inadequate.

River reaeration was tried, therefore, after studies showed that the amount of additional oxygen required to supplement that available in the river water was low enough to permit consideration of mechanical aeration.

There are four hydroelectric power dams along the stretch of river under study. The first of these is located at the paper mill in the city. Sulphite waste liquor from the pulp mill, which produces about 65 tons of pulp per day, is introduced into the river channel just below the mill dam. The city's sewage disposal plant, equipped for activated sludge treatment, has its outfall some 100 yd. farther downstream.

A second power plant is located at the lower dam, 0.7 mi. below the mill dam. Between the pulp mill and the lower dam there is much evidence of sludge bank fermentation from "whitewater" wastes. Excellent mixing is shown, however, from analyses of the water after passing the lower dam and sludge banks are not in evidence below that point.

Aerators in turbine tailraces

Aeration facilities are located at this second dam, where critical conditions of low dissolved oxygen content have been found to start in the river. Layout of these facilities is shown in Fig. 1.

A compressor located in the generator room of the powerhouse furnishes from 1,550 to 1,360 cu. ft. of air per min. in the pressure range of 5 to 15 psi. Thus far, however, air pressures greater than 6.5 lb. have not been required to overcome the hydrostatic head over the aerators as installed.

The original installation of aeration equipment during 1943 and 1944 utilized plate-type diffusers placed in the tailrace only, with 75 one-inch carborundum plates 1-ft. square in each of two "baskets." These plates were closely matched by the manufacturer and have a permeability rating of from 29.0 to 29.9.

The "baskets" were made up of 4x7-in. structural steel angles welded to hold five rows of 15 plates each. Each row was immediately adjacent to the others, thus forming a bed of plates 5 ft. wide and 15 ft. long across the floor of each of the two main tailraces used continuously by power units.

A third basket with three rows of plates was placed in the tailrace below the third turbine. This is used in periods when more flow than required by the first two turbines was available. In the fourth tailrace a single row of plates was tried in 1944.

Large bubbles reduce efficiency

This fourth tailrace is not in use, but it was observed that currents in the tailwater swirled into this tailrace. It was thought advantageous to use the available excess air supply to add more air to that current, and at the same time to take some of the load from the other three sets of plates. These three sets were being called upon to deliver as much as 10 cu. ft. of air per min. per plate, which represented an overload of some five times the recommended capacity of the plates.

It was observed early in the work that the available air supply was not being used efficiently. Even with the rapid current through the tailraces there was violent turbulence above the baskets and large masses of free air rising to the surface. This led to remodeling the tailrace aerator baskets prior to the 1945 season to give at least 2-ft. spacing between rows, thus extending them back in the tailraces under the powerhouse proper. Much improvement was noted as a result of this change (Fig. 2).

Tube-type diffuser equipment was installed in the headrace above the dam early in August, 1945. This was mounted in four sections of 16 tubes

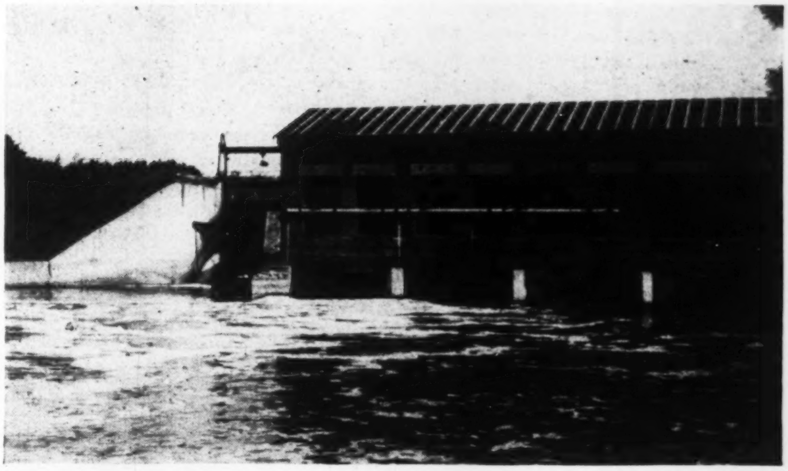


Fig. 2. Bubbles rising downstream from powerhouse indicate intimacy of contact between air and water. Plate-type tailrace diffusers are hung by chains from existing crane rail, which also supports air header.

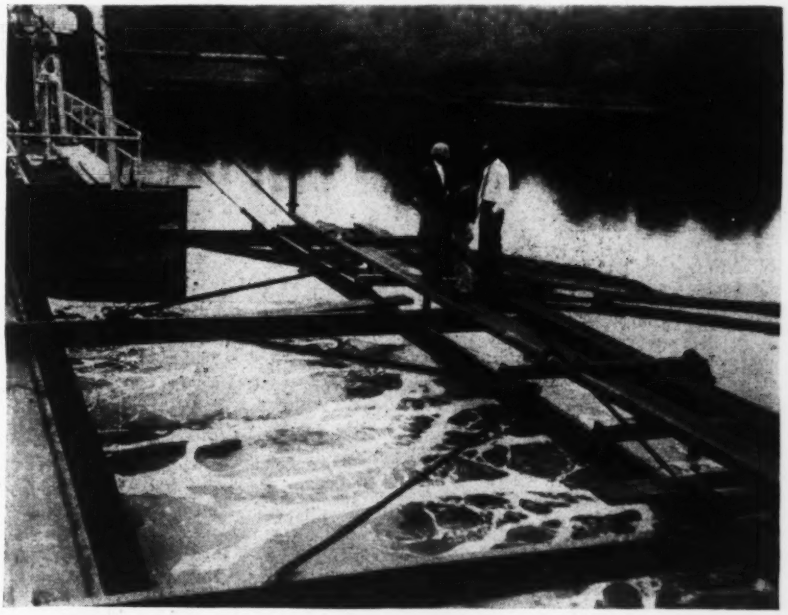


Fig. 3. Tube-type diffusers supported in headrace by stationary support cantilevered upstream from trash rack frame utilize excess air capacity and prolong the contact period between air bubbles and flowing water.

each on stationary holders just in front of the trash racks above the two main turbines (Fig. 3). The permeability rating of the tubes used is about 30. Both headrace and tailrace aerators are placed 12 ft. below the water surface.

After placing the headrace units in operation, still more improvement of aeration efficiency was noted. This was due to further reduction in the amount of air that each diffuser plate and tube was required to handle. Bubble size decreased in the tailrace units and much less turbulence and coalescence were apparent.

Some concern was felt over the possibility of loss in power efficiency of the turbines as a result of aerating in the headrace and also over the possibility of corrosion of the turbine blades. Actually, almost all, if not all, the free air bubbles rise to the surface before entering the turbine intake tube and no adverse effects have been observed.

It is planned to add more tube diffusers in the headrace to avoid the present tendency for water to short-circuit around the ends of the units and to further utilize excess air. In addition, the air will be metered and controlled so that each unit is receiving its proper amount of air.

A short test run during September, 1943, served to show that the dissolved oxygen content of the water could be maintained above 3 ppm. at a point 11 mi. downstream under the experimental conditions then prevailing. Prior to placing the aeration facilities into operation the dissolved oxygen at that point had dropped to 1.32 ppm., remaining below 3 ppm. until reaeration was started.

Calculations based on the daily analytical data for that summer showed that more than 2,000 cfs. of regulated stream flow would have been required to maintain the dissolved oxygen above 3.0 ppm. without reaeration.

Stream conditions improved in 1944

As a result of reaeration during 1944, it was possible to demonstrate from daily data that the dissolved oxygen at the 11-mi. point was slightly higher than without reaeration during 1943, and that the B.O.D. was lower by about 1.5 ppm. Where critical conditions had been observed to persist at the 15-mi. point, there was evidence that with reaeration the stream was recovering from the effects of pollution at this point.

Calculations based on the comparison between daily data for 1943 and 1944 indicate that several thousand pounds of B.O.D. were being satisfied by reaeration during the latter year. And much improvement in stream condition was reported from the resort area below the point of reaeration.

An index of improvement of conditions obtained by installation of the reaeration equipment is seen in comparison of the 1945 figures with those for previous years. With low flows of 720 to 1,100 cfs. during the summer of 1945 and a B.O.D. loading from sulphite waste liquor in excess of 40,000 lb. per day, diffused air aeration of the Flambeau River showed definite improvement in the condition of the stream. This was accomplished with an amount of air equivalent to about 40,000 lb. of oxygen per day.

With efficiency of the reaeration equipment in excess of 5 percent (in terms of the ratio of oxygen absorbed to oxygen delivered), the present installation was shown capable of aiding stream recovery to the point of normal 5-day B.O.D. levels and to maintain the dissolved oxygen at or above 3 ppm. at a location some 18 mi. from the point of discharge of sulphite waste liquor, And while the increase in dissolved oxygen at the 2- to 3-ppm. level is only about 0.6 ppm., for the flows involved (about 1,000 cfs.) this amounts to some 1½ tons of dissolved oxygen added daily.

Thus, the reaeration facilities presently installed are seen to have definite accelerative action on recovery of the stream from the effects of pollution and in shortening the stretch of river involved by at least 8 mi.

Whether or not reaeration of streams receiving wastes with high B.O.D. can be considered to be a complete treatment process will be dependent a great deal on local conditions. It certainly can be regarded as an ameliorating measure in stream sanitation, conclude the investigators.

This project was carried on under the direction of the National Council for Stream Improvement, for which Harry W. Gehm is technical advisor; Averill J. Wiley is in charge of the sulphite waste project.

Other organizations cooperating in the investigations are the Wisconsin State Board of Health, represented by T. F. Wisniewski, senior assistant sanitary engineer; and the Flambeau Paper Co., represented by L. Parkinson, assistant paper mill superintendent. A. F. Bartsch, senior biologist, Wisconsin State Board of Health, carried out the biological studies.

Airport Damage To Nearby Property Considered in Detroit Planning

Estimated loss in value of property surrounding major airport sites is considered in the airport plan for the Detroit metropolitan region prepared for the Detroit aviation planning authority, according to the American Society of Planning Officials.

An attempt is made in the report, which deals comprehensively with the entire airport situation in the metropolitan region of Detroit, to estimate the loss in value to different types of surrounding property because of the location of a major airport.

In the so-called Eight Mile-Wyoming site, which is being urged by the Detroit Board of Commerce, the appraisers show a present value of $4,160,000 for 1200 acres of subdivision. They then show a 74.4 percent loss, or a loss of $3,960,000 to property within one-half mile surrounding the site.

Within the area one-half to one mile surrounding the site, the appraisers show a 71 percent loss, or a total of $4,490,500 affecting 2960 acres of subdivision. The appraisers' total loss in value for farm buildings, residential buildings, subdivisions and farm land is $12,962,000 at this particular site.

At the site recommended by the consultants for the airport plan, namely the Gulley-Fort project, the real estate appraisers show a total loss of $6,191,800 to surrounding property within a one-mile zone.

The authors of the report are of the opinion that the aircraft construction industry will greatly reduce nuisance factors in new planes which would result in recovery of much of the loss in value of property.

Precast Concrete Treads and Platforms Simplify Stair Construction and Repair

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***Contents in Brief**—A troublesome maintenance problem is being solved by the Pittsburgh, Pa., public works department through substitution of precast reinforced concrete treads and platform units for wood stairs in need of repair. Standard details have been prepared for 5- and 6-ft. widths.*

MAINTENANCE of the hundreds of flights of wooden steps scattered over the hills of Pittsburgh, Pa., is an especially difficult problem at present because of the lumber shortage. As a result, a large portion of the existing steps are in such condition that early replacement is necessary. Where possible, this construction will be of reinforced concrete.

In an effort to reduce the cost of construction, and especially of repairs to the stair treads, a new design using precast treads and platform units has been evolved.

Some details of the standard design for 5- and 6-ft. widths are shown in the accompanying drawings.

Open risers shed debris

The steps are designed with open risers to lessen the accumulation of snow, ice or dirt on the treads. Also, to facilitate drainage, the rear half of each tread is sloped toward the open riser space and all units are made ½ in. higher in the middle than at the ends. Non-slip wearing surfaces will be provided by mixing abrasive grains into a mortar placed in the forms prior to casting the tread units in their inverted position.

At intervals of not more than 8 ft., pipe sockets for railing posts will be cast into the concrete stringers. Into these sockets the 2-in. dia. railing posts will be grouted. At these points special precast tread or platform units will be provided with extra-length reinforcing bars extended so that they can be bent around the pipe sockets. Thus, after the recesses around the sockets are filled with cement mortar, the reinforced tread units will act as anchorage for the railing posts and also as lateral struts between the stringers.

Pipe sockets are extended above the tread or platform level to facilitate the bending of the bars. This extension also serves to protect the 2-in. railing posts from rust action at the critical point.

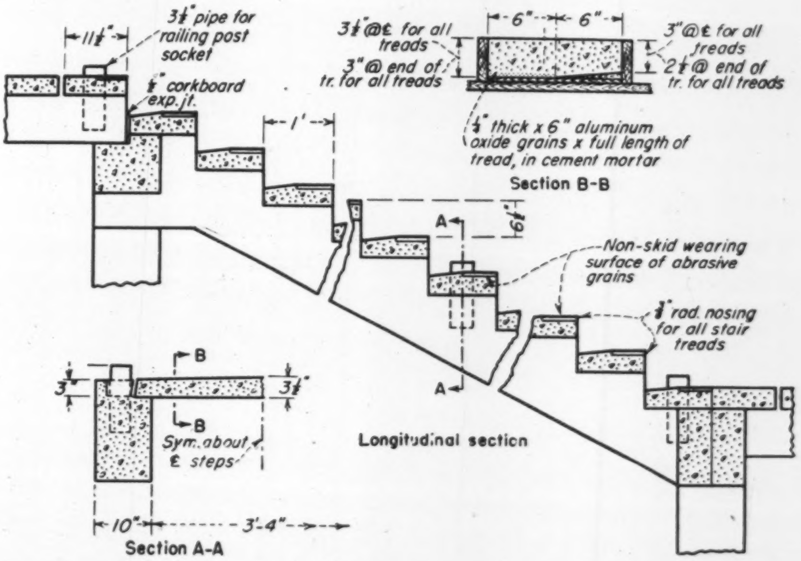
Central-plant casting likely

The treads will probably be cast at some central plant, possibly by a manufacturer of other precast concrete units. They will then be delivered to convenient points while the supporting bents and stringers are being poured in place. If constructed of ordinary concrete, the tread units will weigh about 150 lb. each. Thus, they can be carried easily by two men and placed in position.

After the spaces at the ends of the treads are filled with cement mortar, the bevel ends of the precast units and the beveled recesses in the stringers will serve as keys to hold the treads firmly in place.

It is the intention of the city's public works department to keep on hand an adequate stock of tread and platform units so that repairs can be quickly made, regardless of temperature conditions, by removing any damaged unit and replacing it with a new one from stock. This should prove considerably less expensive than the present method of chipping out the existing concrete to expose the reinforcing steel, placing forms, mixing and placing new concrete, curing and protecting the new work for several days. Also, it will avoid the necessity of waiting for suitable weather before making the replacement, with the danger of an accident in the meantime.

Prompt repair of broken steps is an important factor in reducing accident hazards. At present the city is subjected annually to personal-injury claims running into many thousands of dollars because of accidents attributed to defective steps. It is expected that after the wooden steps and wooden railings are replaced with concrete steps and pipe railings, and with prompt repair made easy by the use of precast units, accidents and resulting damage claims due to defective steps will be largely eliminated.


11½"
3½" pipe for railing post socket
½" corkboard exp. jt.
1'
3½"@℄ for all treads
3"@ end of tr. for all treads
6"
6"
3"@℄ for all treads
2½"@ end of tr. for all treads
¼" thick x 6" aluminum oxide grains x full length of tread, in cement mortar
Section B-B
A
6½"
Non-skid wearing surface of abrasive grains
½" rad. nosing for all stair treads
A
B
3"
3½"
B
Sym. about ℄ steps
Longitudinal section
10"
3'-4"
Section A-A

New design of hillside stairways in Pittsburgh would employ precast concrete treads and platform units. Beveled tread ends and stringer recesses make tight joint when finished with cement mortar. Details of tread form show how non-slip surface is applied and how snow, ice and dirt accumulation is reduced by sloping treads laterally and toward open riser space.

Vibration Damage to Spillway Gates

THE FORCE EXERTED by water surging through partly opened gates whose lower edges were below tail water level and the resultant vibration and hammering in the suspended steel gate structures, damaged four vertical lift gates on the Bonneville Dam spillway during the spring floods of 1945. In each case, the damage was confined to the bottom of the gate on the downstream side. It was not of a very serious nature and can be repaired readily by new members which will be made strong enough, it is believed, to prevent a recurrence of the trouble. Special interest, however, attaches to the conditions that brought about the damage.

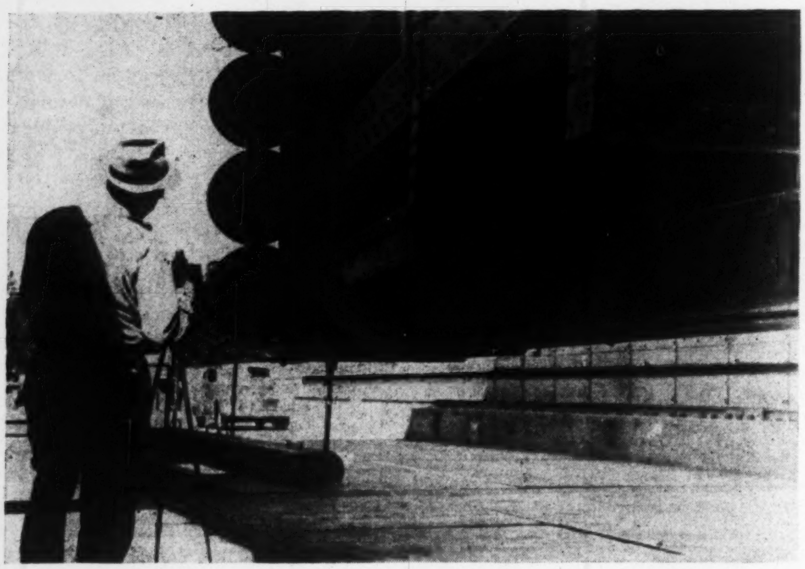


Fig. 1. Lower portion of Gate 17, from which part of bottom girder and bottom fair-water plates have been torn away.

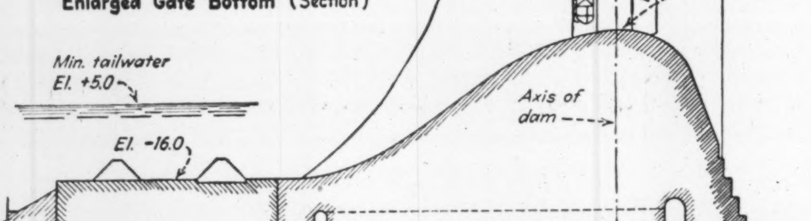


Fig. 2. Section through dam showing lift gate in partly raised position, also enlarged section of gate bottom. Note air holes in fair-water plate.

Construction of Bonneville Dam was described in *ENR* Feb. 11, 1937, vol. p. 219; attacks on steel and concrete immediately below the lift gates was reported in the issue of Mar. 8, 1945, vol. p. 333. Essential facts about the vibration damage to the gates are given in the following.

The spillway section of the dam has built into it eighteen vertical lift gates, each with a horizontal span of 50 ft. between the piers that carry the overhead track and support the vertical rails on which the lift gates move up and down. The three gates nearest to each end of the spillway are 60 ft. high, and the other twelve have a height of 50 ft. It is not necessary that these three high gates at each end of the spillway be opened when the river is in flood because the gate tops rise above the maximum pool level even when the gates are entirely closed.

Due to the fact that it is not necessary to raise these high gates during a flood, gates Nos. 1 and 18, which are at the extreme opposite ends of the spillway, have always been left in closed position. The other four high gates, namely, Nos. 2, 3, 16 and 17, have been raised to a partially opened position, with the lower edges below tail water level, to improve the efficiency of fish ladders adjacent to each end of the spillway section. Operating the high gates in this way during a flood has subjected them to a flow condition in which the gate bottoms are well below tail water level.

Thus the surging and pulsating pressure changes occurring on the downstream side of the partially opened gate have been transmitted to the suspended gate and have caused considerable vibration. A rough measurement on one occasion showed this vibration to be on the order of $\frac{1}{8}$ in. at the top of the gate. Obviously, there was a very severe pounding of the lower portion of the gate under the effect of rollback waves from the tail water.

Prior to the high water season of 1945, no damage to the gates had been observed despite the conditions noted in the foregoing, although operation at full head has continued since 1938. After the high water of April to June, 1945, however, it was observed that damage had been sustained on the bottoms of gates Nos. 2, 3, 16 and 17. In each of these a portion of the fair-water plate at the bottom of the downstream face of the gate had been almost entirely torn away and in one case, gate No. 17, not only had this damage been sustained but the entire central downstream portion of the lower horizontal girder had also disappeared.

This girder is a heavy member, consisting of a well-stiffened ½-in. web plate, 6x6x13/16-in. and 6x4x13/16-in. flange angles and an 11x¾-in. cover plate. It seemed obvious that the damage to the girder had occurred after the fair-water plate had been carried away. In Gate No. 2 similar failure of the lower girder had commenced but had not progressed as far as in the case of Gate 17.

Cause and remedy

As originally installed, the fair-water plates were perforated with air holes on the downstream side of the contact lines at the bottom of the plate (Fig. 2). These holes were intended to assist in reducing or relieving any negative pressure that might occur. It should also be noted that these plates were not very securely attached to the frame of the gate inasmuch as this vibrational stress was not anticipated.

It has been suggested that under the operating conditions described the air holes were not large enough to prevent the pressure differential and particularly the sudden reversals of pressure on opposite sides of the plate. Perhaps the submergence of the gates cut off the circulation of air altogether. It is believed that this, combined with the pounding and vibration caused by the roll-back waves from tail water, first loosened and tore away the fair-water plates and subsequently attacked and damaged the horizontal girder.

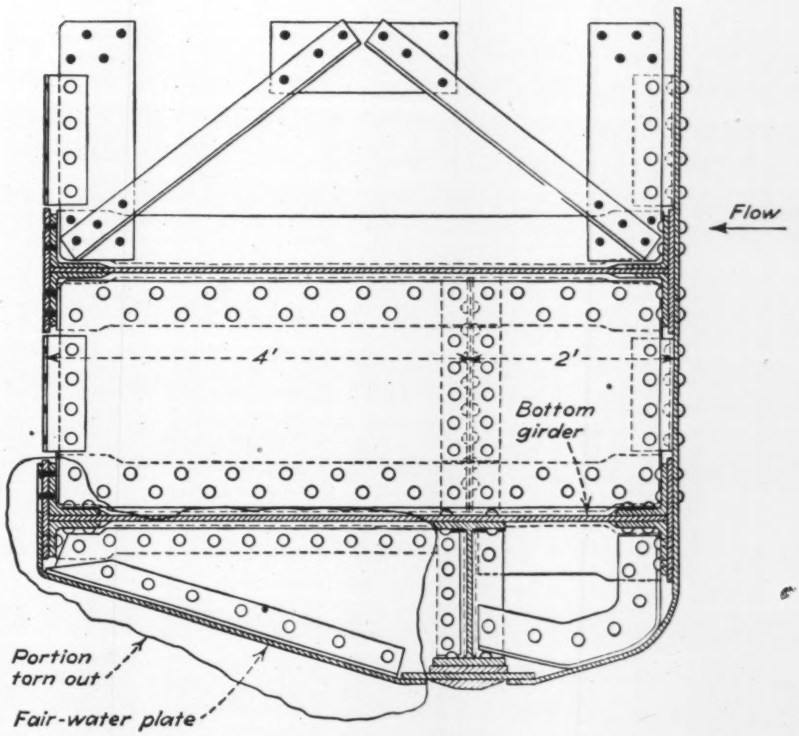


Fig. 3. Plan and section of the girder assembly at gate bottom where parts were carried away after the high water of April to June, 1945.

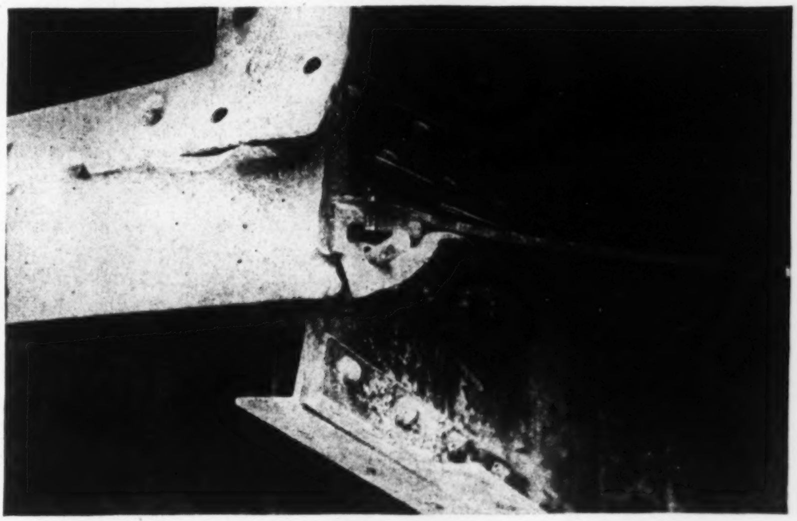


Fig. 4. Closer view of one of the connections in Fig. 3. Parts broken off were ¾x11-in. cover plates, 6x6x13/16-in. flange angles and part of the ½-in. web. All these pieces were covered over and protected by the fair-water plates.

The proposed program is to repair the gates before the next high water season. In doing this, heavier fair-water plates, much more securely fastened to the gate frame than those previously used, will be put in. The assembly will be given much more stiffness by web plates connected to the bottom girder. The new gate bottom thus will have streamlined strength and rigidity greater than before.

In one gate, pressure-measuring devices will be installed to observe pressure changes and to determine whether partial vacuum occur behind the fair-water plate. Studies are being made to see if design changes would reduce the prospect of trouble of this sort.

Discovery of the damage and the observations as outlined in the foregoing were made under the supervision of Col. Ralph A. Tudor, then district engineer, U. S. Army Engineers, Portland, Ore.

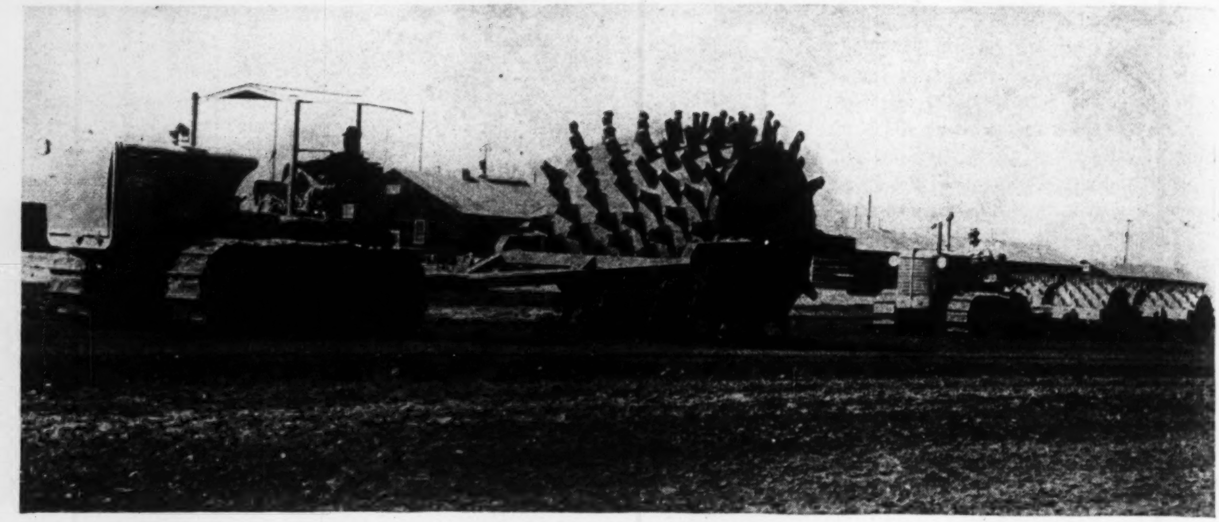


Fig. 1. Giant 75,000-lb. and light standard sheepsfoot rollers compact subsoil and subgrade on taxiway, Mather Field.

Soil Compaction for Airports

***Contents in Brief**—Heavy rollers of both sheepsfoot and pneumatic-tired types have proved their usefulness in compacting bases for airfield pavements. Vibratory rollers possess certain advantages which merit consideration, especially for sandy soils, and the driving of "sand piles" may facilitate compaction of deep, natural loose sandy deposits and sandy hydraulic fills to increase their bearing capacity for airfield pavement, provided a mobile piledriver unit can be developed for that purpose.*

INFORMATIVE TALKS on two methods of soil compaction—by rollers and by vibratory or impact equipment—were delivered at one of the technical sessions of the American Road Builders Association during the 43rd annual meeting in Chicago Jan. 14-17. O. J. Porter, staff materials and research engineer, California Division of Highways, and member of a consulting board for the Corps of Engineers on airport construction, illustrated with excellent slides a discussion of the development of sheepsfoot tamping rollers and pneumatic-tired rollers to present mammoth size: Rubber-tired giants today can be loaded to 200 tons. Gregory P. Tschebotarioff, director of the soils mechanics laboratory, Princeton University, outlined his personal conclusions and recommendations, based on experimental studies, concerning design and use of vibratory compaction equipment. He explored the advantages of developing multiple "sand pile" driving equipment for compacting of loose natural sand deposits or sandy hydraulic fills to depths of 5 ft. or more where needed to support heavy airplane loads.

Compaction by rollers

Mr. Porter emphasized that preliminary field tests of soil compaction by the rolling equipment that is available on the job pay dividends. He recommended that a test section be compacted in successive layers of 3- to 6-in. thickness for each project. A 300x300-ft. preliminary test area compacted on one airfield project included a study of 18 variations in the spreading and rolling procedure and thus developed information that produced higher subgrade stability at a large saving in construction costs.

To anyone interested in the benefits of super-compaction, O. J. Porter recommends obtaining a copy of Technical Memorandum No. 213-1 from the Director, U. S. Waterways Experiment Station, Vicksburg, Miss.

In discussing this subject following the meeting, Mr. Porter stated a general rule that energy required for compacting relatively impervious soils varies roughly as the square of the thickness of the layer. For a 6-in. layer, the number of passes with a roller is about four times the number required for equal compaction by the same equipment on a 3-in. layer, or twice the number of passes for an equal volume of soil.

Heavier equipment permits an increase in thickness of the compacted layer and effects a higher degree of compaction, resulting in construction economies. As an example, curves of compaction tests (Fig. 2) made by the Los Angeles District, U. S. Engineers, on a sandy loam at Clover Field, Santa Monica, Calif. showed that a 60-ton rubber-tired roller was about twice as efficient as the same roller loaded to 40 tons for compacting 6-in. layers.

High compaction was obtained with three or four passes of the 40-ton roller on 3-in. layers, which would be equivalent to six to eight passes for each 6-in. thickness of the material. Four to eight passes of the heavy standard sheepsfoot prior to rolling with the 40-ton rubber-tired roller did not materially aid in obtaining high density. After these preliminary tests, superior compacting averaging approximately 100 percent of modified AASHO density was obtained on the project by spreading the material in 3- to 6-in. layers and rolling with heavy rubber-tired equipment loaded to 60 to 100 tons.

Heavy cohesive soils such as clays must be placed in thin layers to expel the entrapped air readily and efficiently. Sandy soils are readily compacted. More energy is consumed in compacting cohesive soils. Efficient compaction of soils ordinarily requires controlled moisture for lubrication of the soil particles to facilitate consolidation as the air is squeezed out, but sandy desert soils can be compacted dry in very thin layers with heavy rollers where addition of water is uneconomical or impractical.

Sheepsfoot rollers

In Mr. Porter's words, there continues strongly today the same trend toward heavier rollers which started soon after the first Fitzgerald tamping-type unit (Fig. 5) was introduced and used at Santa Monica, Calif., in 1904-05-06, with a bearing pressure of 40- to 50-psi. under the feet. Sheepsfoot rollers now in use are of three sizes: the light standard (Fig. 6), 42-in. drum, 100-300 psi.; the heavy standard (Fig. 7), 60-in. drum, used for the last 8 or 9 years, weighing today 35,000 lb. in 8-ft. length, fully loaded, capable of delivering 300-600 psi. under a selection of removable feet of 7 to 12-sq.in. bearing area; and the giant (Fig. 1), 8 ft. in dia., weighing 75,000 lb., with feet on legs 18 in. long which compact efficiently to depths of 12 to 24 in. and develops pressures ranging from 400 to 1,000 psi. The latter roller was built to specifications prepared by the Sacramento District, U. S. Engineers.

At Mather Field, the Army Engineers employed the three sizes in sequence—the giant, the heavy standard and standard, and then a 75-ton rubber-tired roller for effective compaction of the natural clay-loam subsoil and subgrade. An experimental oversize roller (Fig. 8) being tested at the Waterways Experiment Station, Vicksburg, Miss., exerts pressures of 260 psi. when empty to 1,080 psi., when loaded with slurry.

Pneumatic-tired rollers

Many California fills are compacted in thin layers to high density with loaded, large-model, rubber-tired tractor-drawn scrapers. High embankments compacted in 4-in. layers and at optimum moisture content in 1929 with the first large tractor-drawn scrapers have not settled sufficiently during the last 17 years to require resurfacing.

Standard specifications of the California highway department requires that the subsoil and subgrade be highly compacted in not more than 4-in. layers to a depth of at least 3 ft. below profile grade. In cut sections, the material is removed, replaced and compacted where necessary to obtain high density and high stability in the foundation for heavy-duty pavements.

To duplicate the footprints and load conditions of heavy planes on pavement tests, special rubber-tired rollers have been built with the load box in two parts, each running on a dual rubber-tired wheel. The boxes can be joined

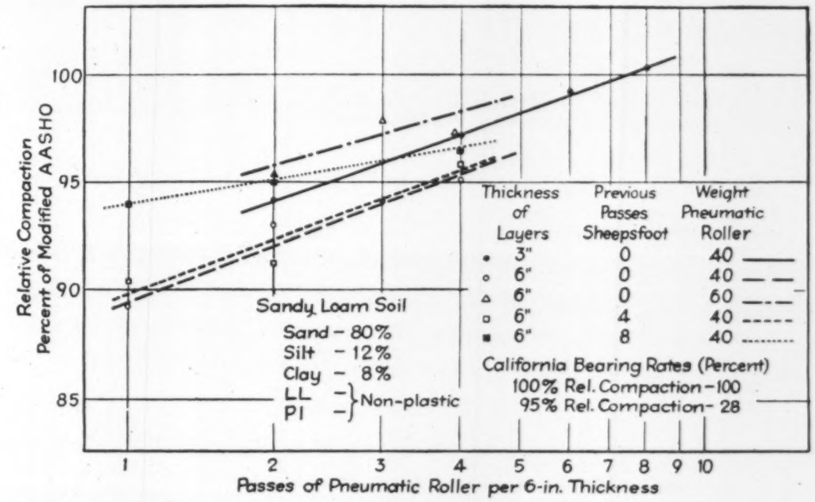


Fig. 2. Compaction tests on preliminary test section show efficiency of various types of rollers on 3- to 6-in. layers of sandy loam soil.

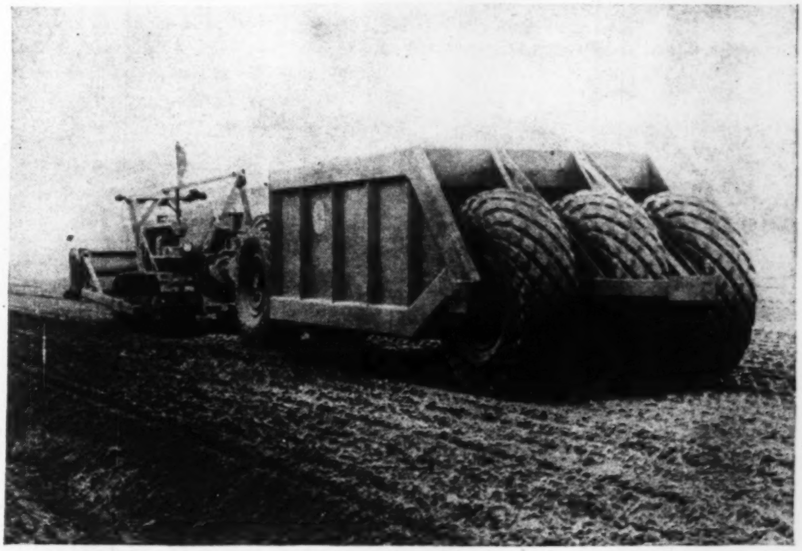


Fig. 3. 100-ton rubber-tired roller (five 24x32-in. tires) conforming to specifications of Pacific Division, U. S. Engineers, is furnished by contractor for compacting embankment and subgrade on airfield construction at Clover Field, Santa Monica, Calif.

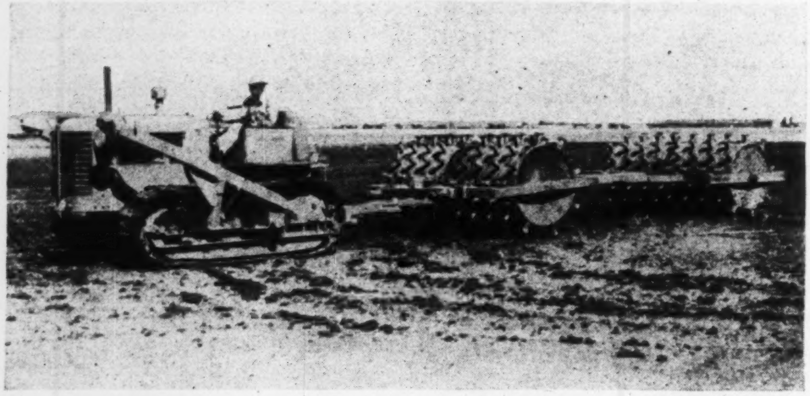


Fig. 4. Heavy standard sheepsfoot (60-in.-dia. drum) is used on preliminary test, Clover Field, Santa Monica, Calif.

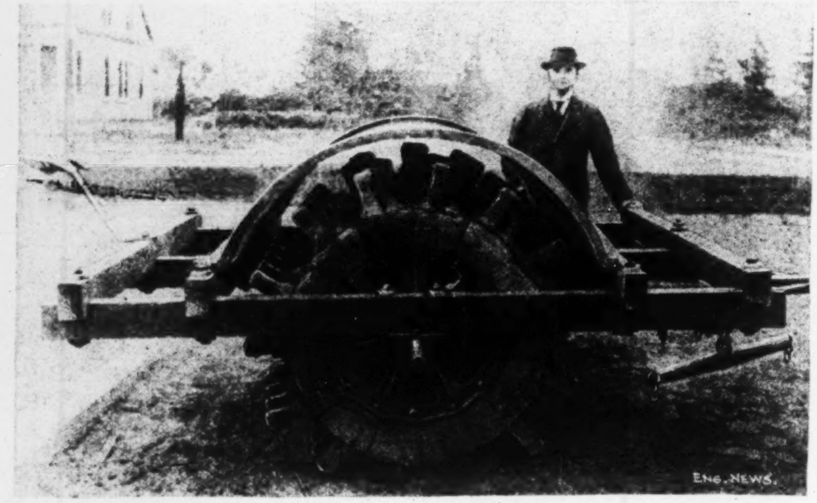


Fig. 5. Original Fitzgerald sheepsfoot roller developed and used in Santa Monica, Calif., 1904-1906, weighed 5,000 to 6,000 lb.

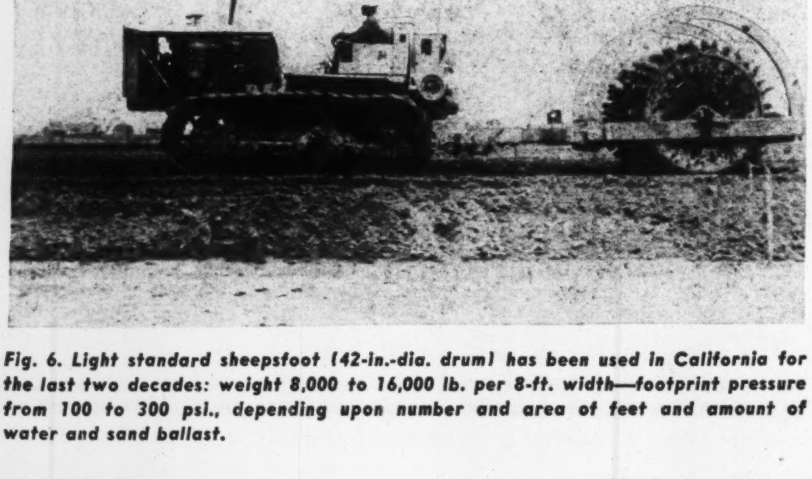


Fig. 6. Light standard sheepsfoot (42-in.-dia. drum) has been used in California for the last two decades: weight 8,000 to 16,000 lb. per 8-ft. width—footprint pressure from 100 to 300 psi., depending upon number and area of feet and amount of water and sand ballast.

to form a unit on a pair of dual wheels for subgrade compaction.

A 75-ton rubber-tired roller equipped with two dual wheels, first employed at Mather Field in 1944, was used extensively on West Coast airport projects in that year and 1945. It was designed by the Pacific Division, U. S. Engineers.

Variable-spread rollers

Mr. Porter showed a picture of one roller (Fig. 9) with the two parts spread 25 ft. c. to c., duplicating the footprints of one type of plane. To simulate another type of plane, the boxes can be spread 44 ft., c. to c. of footprints. These boxes loaded to about 280,000 lb. rode on a total of four 36x40 tires.

This roller was used to complete the compaction of the subgrade for a B-29 base at Mather Field after the initial rolling with sheepsfoot rollers (Fig. 1) and also to consolidate layers of base course subsequently placed. This procedure proved to be a very efficient method of stabilizing the foundation and made it possible to reduce the thickness of base by 12 to 24 in. on the runways and taxiways, thus effecting a large saving in construction cost.

At Fairfield-Suisun airbase, a 120-ton three-wheel roller (Fig. 10) on six rubber tires has also been used to compact the subgrade for runways, taxiways and aprons designed to take 300,000-lb. airplanes. Aircraft of this weight induce stresses of about 7 tons per sq. ft. with relatively high intensities extending to depths of 5, 6 and 7 ft. The heavy rollers produce equal effects in consolidating and testing the foundation, thus eliminating settlements and failures subsequent to pavement construction.

Airplane tire pressures

Tire pressures are going up, Mr. Porter stated. To the present, airplane tires have carried air pressures of 40-45 and up to a maximum of 60 psi. In the future, they may be inflated to 100-110 psi. and possibly to 200 psi. These higher pressures will further concentrate the load on the pavement. He stressed that high compaction, equal to or greater than the modified AASHO density, which is comparable to that produced by the impact test used by the California Division of Highways since 1929, is essential to economical construction of foundations for these heavy loads. It was pointed out that the extensive research work of the Army Engineers, during the war years, has added greatly to knowledge regarding the economical use of soils and bases for heavy duty pavements.

Vibration and impact methods

Discussing possible new, unconventional types of compacting equipment, Prof. Tschebotarioff said they may be divided into two main categories: (1) units producing vibrations for the purpose of facilitating soil compaction and also of magnifying at resonance the static load of the unit transmitted to the soil, and (2) units producing compaction by the impact of heavy weights against the soil surface.

With reference to the effect of vibrations on soils, he summarized his own conclusions, based on earlier findings of the Soil Mechanics Laboratory at Princeton University for the Technical Development Service of the Civil Aeronautics Administration, as follows: (1) As compared to static forces of equivalent magnitude, vibratory forces are many times more effective in compacting sands, but vibratory forces are not any more effective in compacting clays; (2) the compactive effort of a static load can be magnified several times on any soil if the load is vibrated at the natural frequency of the load-soil system, i.e. at so-called "resonance"; (3) interposition between the vibrator and soil of any type of springs, including pneumatic tires, appreciably reduces the compactive vibratory forces transmitted to the soil.

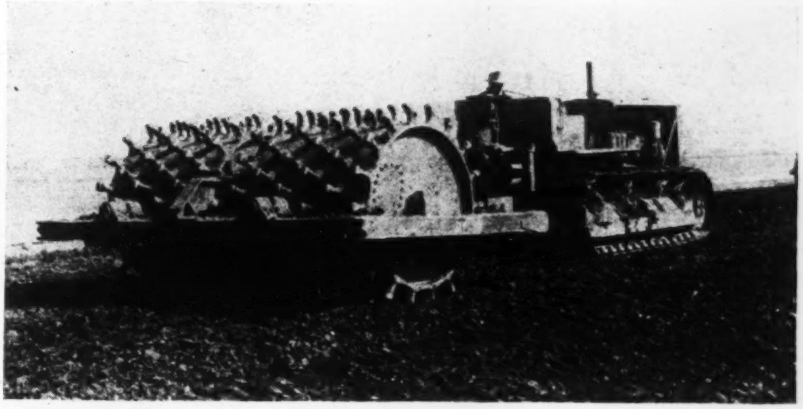


Fig. 7. Heavy standard sheepsfoot (60-in.-dia. drum) has served in western states for 8 or 9 years on earth dams and also on subgrades where high compaction is required. Weight, 35,000 lb. when fully loaded. Similar size of roller, being used by U. S. Waterways Experiment Station for compaction studies, weighs 41,000 lb. when loaded producing a footprint pressure of about 740 psi.

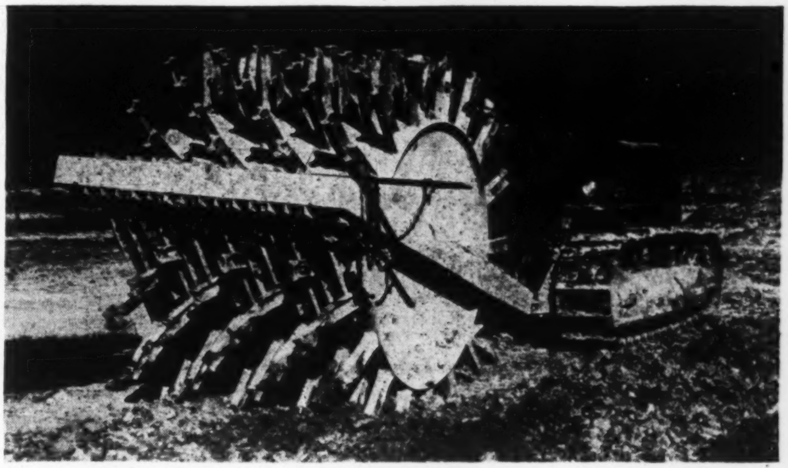


Fig. 8. Oversize experimental roller is now being tested by Waterways Experiment Station, U. S. Engineers, Vicksburg, Miss.

As his personal opinion, developed as a result of the summarized findings, Prof. Tschebotarioff expressed the thought that it is doubtful whether there would be any economy in building light vibratory rollers for the sole purpose of using them at resonance frequencies of the roller-soil system to amplify the compactive effort of the light static weight of the roller. In his opinion, it would probably be much more economical and certainly much simpler to build correspondingly larger and heavier rollers for compaction of clay soils. Particularly, he said, it is unlikely that there could be any possible advantage in using any kind of vibratory roller equipment for the compaction of clay soils.

With regard to vibratory compaction of sands, Prof. Tschebotarioff pointed out that the following additional points should be considered: (1) Pneumatic-tire rollers are known to be the most efficient type of roller for compacting sands; (2) vibratory forces applied to a pneumatic-tire roller apparently would be greatly dampened by the action of the tires; (3) to be effective, vibratory forces must be applied for some time at one spot, necessitating slow progress of the vibratory compaction equipment. These opposed factors prevent a final expression of opinion as to whether or not vibratory rollers would be economically advantageous for compaction of sands.

Studies carried out by the U. S. Engineer Experiment Station at Vicksburg on soils compacted by laboratory dynamic impact methods have led to the following statement by Joseph W. Eustis and John L. McRae: "For soils of low plasticity showing little or no swell, the California Bearings Ratio (modulus of shearing resistance) and unconfined compressive strength of dynamically compacted and soaked specimens are approximately two and one-half times as great as those of statically compacted and soaked specimens."

Should these findings be further substantiated, Prof. Tschebotarioff said, field impact compaction of clay soils will have to be given serious consideration.

As a possible solution of the special problem presented by deep, loose, natural sandy deposits which cannot be compacted effectively by action on

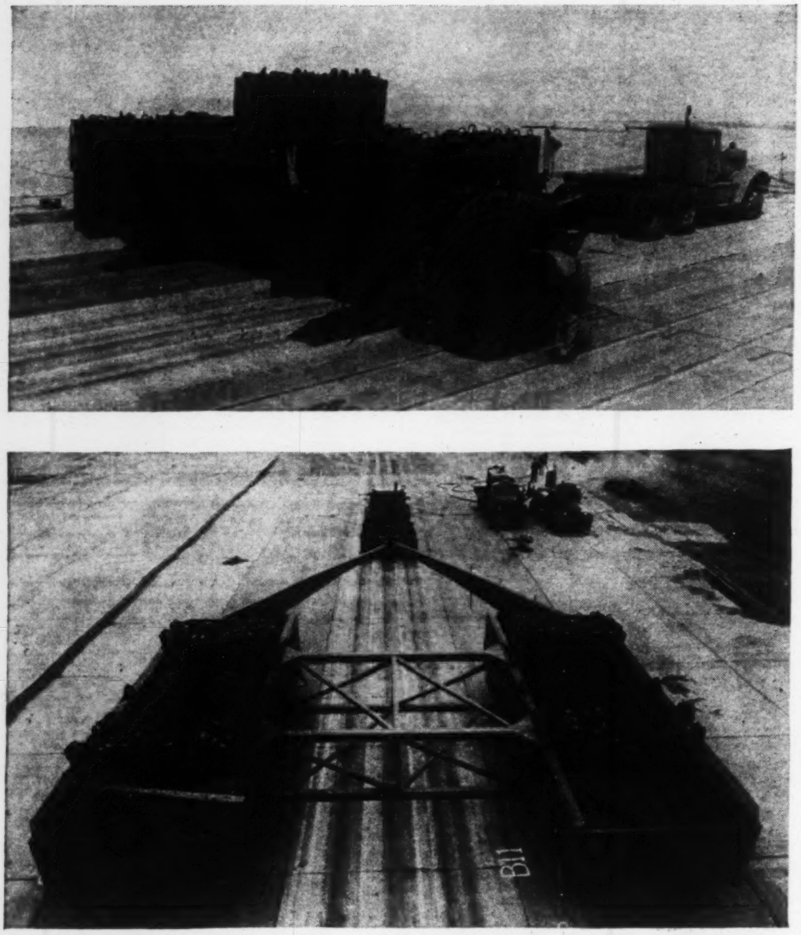


Fig. 9. A 75-ton roller with spreader (top) makes traffic test on a special pavement test section in 1944. It produced loads comparable to those of a B-29 plane. Below is shown another rubber-tired roller and test rig designed to test pavement under gross load of 280,000 lb.

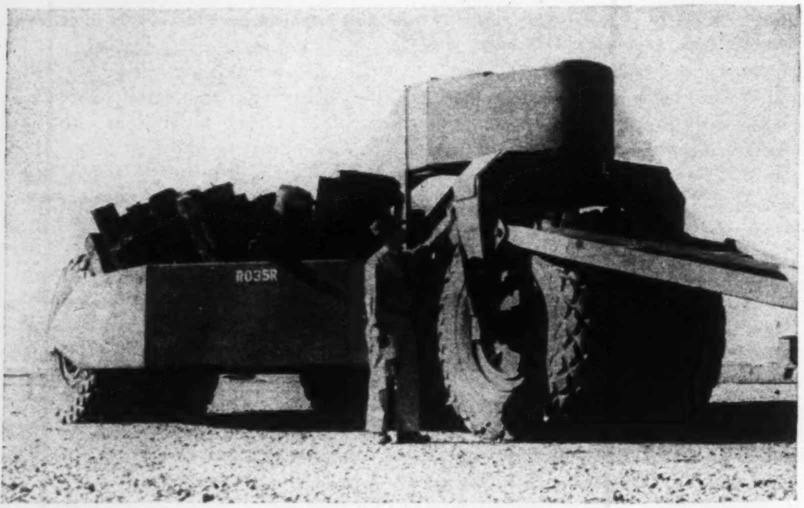


Fig. 10. This 120-ton rubber-tired roller was used to compact the subgrade and base on Suisun-Fairfield Army Airbase in 1945. The roller was built by equipment manufacturer to specifications of Sacramento District and Pacific Division, U. S. Engineers.

their surface, Prof. Tschebotarioff suggested that development of a multiple pile-driver for installing "sand piles" might be worthy of careful investigation.

In his words, it has long been known that the compaction of deep, loose sandy deposits for building foundations can be most efficiently and economically achieved by means of these sand piles. Compaction takes place twice: first while the casings are driven into the ground, and again while additional sand is fed into the casings and is tamped in further as the casings are withdrawn. No specially made shoes or shell-casings are left in the ground.

Existing types of piledrivers, installing one pile at a time, are too unwieldy and too slow for compacting, by means of sand piles, large areas of sandy deposits or hydraulic fills to a depth of 7 to 15 ft., the maximum depth which may be required in airport work. A multiple sand pile-driver, as proposed by Prof. Tschebotarioff, would permit simultaneous deep compaction of a sandy deposit over the full width of an airport lane, perhaps 25 ft. wide.

He suggests a machine capable of driving two rows of sand piles across the whole width of the strip. Such a machine, in his opinion, would remedy the chief defect of hydraulic fills—the fact that they are very loose.

A machine of this type, he said, could be used in connection with a battery of "vibroflotators". ("Vibroflotation" is a patented process for consolidating granular soils in which a large vibrator is sunk to the desired depth of soil consolidation with the aid of water jets, and then is withdrawn as other jets are used to loosen the soil around the vibrator. The vibration causes the loosened soil to settle back in a more consolidated form.)

A multiple sand pile driver would have the advantage of efficient operation not only in clean sands, but also in silty sands, such as in hydraulic fills, where the efficiency of the so-called Vibroflotation method of soil compaction is more than doubtful, in the opinion of Prof. Tschebotarioff. Compaction of pavement foundations for airports by means of multiple sand pile drivers is likely to prove an expensive procedure; but when applied to hydraulic fills, the cost probably would be no greater than the expensive method of trucking in additional material and rolling it in layers.

American Concrete Institute Discusses Precasting, Prestressing, Entrained Air

***Editor's Note**—Into the six technical sessions of the 42nd annual convention of the American Concrete Institute, held at Buffalo, N. Y., Feb. 19-21 (ENR Feb. 28, vol. p. 309), was poured the pent-up data on concrete design and construction that had been developed during the war years. Almost no phase of present day practices was overlooked. Sessions included symposiums on innovations in design and construction methods, on maintenance and repair, on research now under way and on entrained air in concrete.*

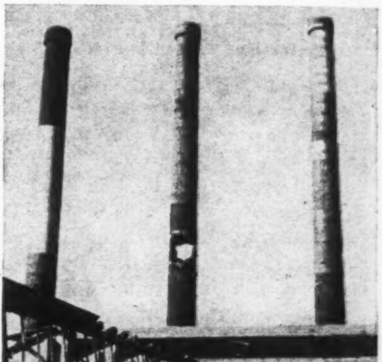
AT A SESSION devoted to miscellaneous topics at the American Concrete Institute 1946 annual meeting, Capt. E. H. Praeger (CEC) USNR, reported on "Observations of the Effect of Atomic Bombs on Reinforced Concrete Structures—Hiroshima and Nagasaki." Capt. Praeger and a group of technical experts had visited the devastated areas to obtain data that might be used to develop criteria for designing structures capable of withstanding any type of bomb.

It was observed that while reinforced concrete buildings suffered severe local damage, in most cases the structural frame proved capable of withstanding the blast of the atomic bomb. Another significant point was the amazing resistance of chimneys to the A-bomb blast. These facts point to the importance in design of the period of vibration of structures and indicate that design against A-bombs is a problem in structural dynamics. Capt. Praeger expressed the belief that fireproof structures capable of withstanding the impact of high explosive missiles might also offer satisfactory resistance to blast pressures of A-bombs.

Cement dispersion

T. C. Powers, manager of basic research, Portland Cement Association Research Laboratory, ventured an answer to the question, "Should portland cement be dispersed?" Observations have indicated that cement particles tend to flocculate and some engineers, believing that this condition interferes with hydration, have advocated cement dispersion as beneficial to concrete. Mr. Powers believes that total destruction of flocculated groups would increase bleeding and decrease plasticity. While it would reduce the water requirements for a given slump, it would not improve workability except in unusually rich mixes. Furthermore, since tests have shown that even when particles are flocculated the whole surface is exposed to water, dispersion would not improve hydration. Hence, complete dispersion is not desirable.

However, Mr. Powers pointed out that none of the commercial dispersing agents causes complete dispersion when used in the quantities recommended, but they may effect a reduction in interparticle attraction. In addition, these products are generally air-entraining agents and some also contain an accelerator. Air entrainment offsets the undesirable effects of reduced interparticle attraction and plasticity and decreases bleeding, while the accelerator counteracts any tendency to retard hydration.



Reinforced concrete stacks in Japan resisted bomb blasts. Weight of material above 12-by-8 ft. hole in center chimney is about 80 tons.

Discussers pointed to confusion in definition of terms and a need for quantitative evaluation of reduced interparticle attraction. As an example of possibilities of improving strength through dispersion, tests were cited by E. W. Scripture, Jr., director of research, The Master Builders Company, in which the strength of concrete increased for about one year. But that this might be due to continued hydration appeared to be contradicted by observations of others on the effect of adding water to a dry paste. Water rapidly penetrated to all particles, it was claimed.

A third paper at this session, "Curing Concrete with Sealing Compounds," by Robert F. Blanks, H. S. Meissner and Lewis H. Tuthill, all of the U. S. Bureau of Reclamation, discussed the method by which the bureau evaluates these compounds in terms of equivalent days of moist curing. White compounds are used to cut down temperatures due to radiant heat.

Entrained air in concrete

A whole session, in which twelve papers were presented, was devoted to entrained air in concrete. Opening the symposium with a talk on "Laboratory Studies of Concrete Containing Air-Entraining Admixtures," C. E. Wuerpel, engineer in charge, Central Concrete Laboratories, North Atlantic Division, U. S. Corps of Engineers, pointed out that benefits of air entrainment lie primarily in the type and amount of air and not in the agent as such. However, the admixture must be uniform and relatively insensitive to variation in quantity. It must be added to the concrete in a form that is available immediately for producing air.

Grading of aggregates, fineness of cement, consistency, type of mixer, mixing time and method of placing concrete affect air entrainment. Benefits obtained are significant, if the air content is controlled. Therefore, it is best to add the agent at the mixer, according to Mr. Wuerpel.

Relationships for use in the design of concrete mixes with nominal amounts of air were presented by W. A. Cordon, engineer, U. S. Bureau of Reclamation. He stated that a one percent increase in air was equivalent to a reduction of about 6.4 lb. of water per cubic yard of concrete. Workability and slump are unchanged if the amount of sand is decreased by about one percent for each percent increase in air, but with the same slump and mix workability increases with air. Concrete with the same water-cement ratio and aggregate grading suffers about 195-psi. reduction in compressive strength and 105,000-psi. decrease in modulus of elasticity with each percent increase in air.

Performance reports

Abrasive tests on air-entrained concrete described by Henry L. Kennedy, manager, cement division, Dewey & Almy Chemical Co., apparently indicated that resistance to abrasion decreases with air content, with serious effect on concrete when there is over 10 percent air. Freezing and thawing tests on blends of natural and portland cement reported by W. F. Kellerman, senior materials engineer, Public Roads Administration, showed that best results occurred with about 3 percent air. Tests reported by Stanton Walker, director of engineering, and Delmar L. Bloem, associate research engineer, National Ready Mixed Concrete Assn., indicate that increasing the temperature during mixing resulted in reduced entrained air content.

Other papers in this symposium included field reports on highways constructed with air-entrained concrete, description of an apparatus for measuring entrained air, and reports on experience in ready-mixed operations and the use of mechanical devices for dispensing admixtures. The reports on durability of air-entrained concrete were favorable.

In a symposium of new developments in concrete design, John R. Nichols, consulting engineer of Boston, Mass., discussed some of the problems faced by structural engineers in connection with radiant or panel heating. He pointed out that although radiant heating has been successfully used for many years, present ACI regulations prohibit embedment of pipes with internal pressure greater than atmospheric pressure by one pound per square inch. Prohibitive rules of this type, he said, should be re-examined in the light of present-day engineering practice.

Panel heating poses problems

Certain conditions due to radiant heating that might be structurally objectionable were considered by Mr. Nichols and shown not to be serious obstacles.

In discussing this paper, Peter B. Gordon of Wolff & Munier, Inc., gave some additional information on surmounting these barriers. Pipe completely embedded in structural concrete, he said, is entirely free from corrosion unless there exists an external corrosive agent that would leak through the concrete to affect the pipe and the reinforcing members. On the other hand, cinder concrete is extremely corrosive. The inside of the pipe will also be resistant to corrosion if the heating medium is circulating warm water. He recommended avoiding the use of steam or vapor-vacuum systems because of the possibility of corrosion. He also pointed out that thermal stresses set up in the piping system are of a very low magnitude as compared with normal stresses set up in similar materials used for the reinforcing of structural concrete.

Prestressing of floating structures

Another paper in this symposium discussed prestressed concrete in floating structures. Henri Marcus, Bureau of Yards and Docks, U. S. Navy, said that designers of floating concrete structures are faced with the problem of specifying as thin a hull as possible to reduce dead loads and yet one that will be free of cracks and perfectly watertight in spite of great strains. Conventional designs requiring high percentages of steel give rise to difficulties in placing concrete and in providing for high shrinkage stresses.

Sensing that prestressing might be a solution to these problems, the Bureau of Yards and Docks decided to investigate the practicability of the prestressing operation and the efficiency of various types of reinforcement and prestressing devices by experimental construction of a 250-ton concrete barge. This structure was 110 ft. long, 30 ft. wide, and had a maximum depth of 9 ft. 9 in., with a draft of 4 ft. 3 in. for 335 tons dead load and a draft of 6 ft. 10 in. for 585 tons total load. The hull was 4 in. thick, stiffened by five transverse bulkheads 20 ft. apart, and three longitudinal bulkheads about 7 ft. 6 in. apart.

The main reinforcing, placed transversely at 12 in. c. to c., consisted of units each composed of 16 wires, 0.2 in. in diameter, assembled on short springs or pipes of 1-in. diameter, providing space for grouting after prestressing. The wires were cold drawn with a yield point of 200,000 psi. and an ultimate of 220,000 psi.

At the jacking points, the wires were subjected to 120,000 psi., but shrinkage, elastic deformation and plastic load reduced this to 90,000 psi. Decreased still more by friction losses, the prestress finally available was 70,000 psi., giving a final precompression in the concrete of 671 psi. as compared to the greatest bending stress anticipated of 669 psi. Unfortunately, when the forms were stripped, cracks were found in the concrete, but nevertheless the craft proved to be seaworthy.

Other papers in this symposium included a description by George Winter, assistant professor of civil engineering, Cornell University, of hipped plate construction, known abroad as *Faltwerke*, and an exposition by Douglas McHenry, U. S. Bureau of Reclamation, of a simple arithmetical method for solving many complicated problems of stress distribution, utilizing a lattice analogy.

Developments in construction

The symposium on innovations in construction methods included papers on such topics as prefabricated concrete structures, the use of vacuum methods in precasting and erecting light-weight precast structural units, and the H-beam and Prepakt method of bridge pier construction.

This last procedure was described by C. P. Disney, bridge engineer, Canadian National Railways, who claimed that it made pneumatic caissons obsolete. Used successfully for construction of deep-water piers, the method involves carrying the superstructure load on H-beam piles, braced by concrete. After the piles are driven, they are enclosed by steel sheet piling and aggregate dumped in, tamped and consolidated with mortar.

A. Amirikian, principal engineer, Bureau of Yards and Docks, U. S. Navy, pointed out that the use of thin sections has led to the development of new methods of construction because of the difficulty of placing concrete in heavily reinforced walls in a vertical plane. Thin sections can be cast satisfactorily in a horizontal plane, he said, so that thin vertical sections may be obtained by precasting horizontally. He expressed the belief that prefabricated concrete structures can compete with other materials of construction and described prefabricated structures built by the Bureau of Yards and Docks, including rigid-frame warehouses and cellular barges composed of thin-shelled open-end boxes.

F. R. MacLeay, chief engineer, Corbetta Construction Co., described how the concrete boxes were cast through the use of rotating forms. The long side of the boxes was cast 1½ in. thick and the short side ¾ in. thick, to which ¾ in. of pneumatically placed concrete was added later.

Among the many papers presented in the symposium on maintenance and repair of concrete was one of unusual interest on two special methods of restoring and strengthening masonry structures, by J. W. Kelly, associate professor of civil engineering, University of California, and B. D. Keatts, engineer, Intrusion-Prepakt, Inc. Methods they describe for structures and foundations damaged by weather, erosion, scour of settlement involve: (1) Pumping cement-base stabilizing material into small interstices and (2) the filling of larger spaces by aggregate into which consolidating grout is forced. The former is known as intrusion, the latter as Prepakt.

Paper Mill and Power Project Planned in Northern Ontario

Construction of another pulp and paper mill on the north shore of Lake Superior and a hydro plant to supply it with power has been announced by Premier George Drew of Ontario. The new mill will be near Schreiber, a division point on the Canadian Pacific Ry. It will be the third to be built on the rocky north coast of Lake Superior within the last few years. The Lake sulphite plant at Red Rock, near Nipigon, was recently placed in production by the Brompton Pulp and Paper Co. and construction at present is proceeding on the new Marathon mill at Peninsula (*ENR* Feb. 17, 1944, vol. p. 229: July 19, 1945, vol. p. 75).

The new paper mill and its associated town will be built by the Long Lac Pulp and Paper Co., a subsidiary of the Kimberly Clark Corp. of Neenah, Wis., at an estimated cost of $15,000,000. It is hoped to have the mill in operation by 1947.

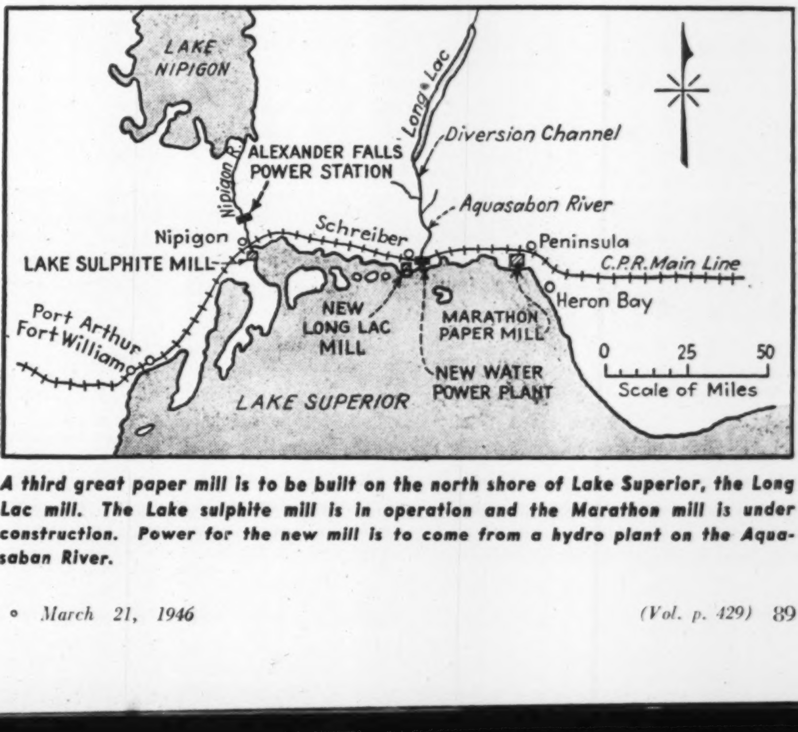
Access to the site will be by water, with good harbor accommodations, by the C.P.R. main line, and by the Trans-Canada Highway when the section linking the existing section of the road to the lakehead district is completed

Power for the paper mill will be supplied ultimately from a water power plant to be built by the Hydro Electric Power Commission of Ontario on the Aquasabon River, not far from the mill. The Aquasabon is one of the rivers through which water from streams that normally flow north to Hudson Bay have been diverted into the St. Lawrence River basin, (*ENR* July 15, 1943, vol. p. 158).

This diversion was made primarily to increase the power supply in the Niagara district but also to increase the power possibilities of the streams through which the diversions are made and to facilitate the movement of pulpwood to mills on Lake Superior. Similar diversion is made into Lake Nipigon.

The new power station will develop 45,000 hp., of which 15,000 hp. will be used at the new mill. It will be tied in to the Alexander Falls station on the Nipigon River. Cost of the transmission line is estimated at $1,500,000 and the power plant at $8,500,000. The plant is scheduled for completion in 1948.

Other major industrial developments at present under construction in northern Ontario are the building of a new parchment plant at Espanola, costing $10,000,000: expansion of paper making facilities at Kapuskasing by the Spruce Falls Pulp and Paper Co., at a cost of $10,000,000; and similar extensions by the Minnesota-Ontario Paper Co. at Fort Francis to cost $6,000,000.



A third great paper mill is to be built on the north shore of Lake Superior, the Long Lac mill. The Lake sulphite mill is in operation and the Marathon mill is under construction. Power for the new mill is to come from a hydro plant on the Aquasaban River.

More Water for the Nation's Capital

***Contents in Brief**—A comprehensive improvement program has been submitted to Congress to provide an adequate supply of water for the District of Columbia and Arlington County, Va., for the ultimate population that can be expected by the year 2000. Essential improvements and extensions of the water system to cost about $41,000,000 have been planned, the construction of which is to be spread over a period of 43 years.*

PURSUANT to a directive from Congress for the development of a plan to insure an adequate future water supply for the District of Columbia, the engineer commissioner of the District of Columbia and the district engineer of the U. S. Engineer Office, Washington, D. C., have prepared a joint report which develops and describes a comprehensive plan and program for the construction of improvements and additions to the water system of the District of Columbia and the metropolitan area including Arlington County, Va. The plan provides for the necessary facilities to produce and distribute a potable water to meet safely and adequately the anticipated future demands due to population growth during the next half century.

While the report contemplates an overall expenditure of about $22,000,000 for supply facilities and $19,000,000 for distribution facilities during the ensuing 43 years, the principal works for an increased water supply and the major distribution improvements will be constructed during the next 14 years. In general the plan provides for the facilities to produce an uninterrupted supply of water of the highest degree of purity and in ample quantity by means of pumping and gravity transmission of raw water, pretreatment and sedimentation of suspended matter, filtration, corrective chemical treatment and sterilization, and final distribution to the consumers.

The comprehensive plan is the result of several years of cooperative and coordinated effort of the engineering staffs of the Washington Aqueduct Division of the U. S. Engineer Office and the Water Division of the District of Columbia in productive study, investigation, and planning.

Extensive studies were made of the population trends of the District of Columbia and Arlington County, Va., as these areas are wholly supplied with water by the Washington water system. General consideration was given on a metropolitan basis to those communities of Fairfax County, Va., adjacent to Arlington County, which, in the future, may become users of water supplied by the District of Columbia water system. The future population of the area served by the water system is estimated to be 1,455,000 by the year 2000. Capacities of the proposed supply and distribution improvements were set to meet the maximum water demands of this population.

In order to determine the proper site for the location of an additional purification plant, various schemes were studied. Based upon economic consideration and other favorable factors, the Dalecarlia area was selected as the site around which the comprehensive plan was developed.

Anticipated water demand is the basis for determining when new facilities will be needed. As far as possible the program has been spread out over such a period of years as to entail moderate annual expenditures and keep any outstanding debt as small as practicable without increasing water rates.

Additional raw supply needed

In the Dalecarlia area many important water system improvements will be constructed. First among these is increasing the filtering capacity of the present 85-mgd. plant, completed in 1928, to a total of 217 mgd. through plant extensions. This will require a new chemical building, larger sedimentation basins, and a larger pumping station. Here, also, a new 30-mg. clearwater reservoir will be provided.

As the two existing conduits can only deliver 233 mgd. from Great Falls to the filter plants in the city and the requirements in later years will total 427 mgd., an additional raw-water supply must be secured. Studies indicate that the most economical and desirable method will be to construct a permanent diversion dam across the river just above Little Falls (at High Island), where the present loose rock feeder dam for the C & O Canal is located. With this dam there goes a pumping station and a pipe line and tunnel only ½-mi. long to deliver the water into the Dalecarlia reservoir. All of the improvements in the Dalecarlia area will cost about $13,482,000; they are scheduled for completion by 1961.

Floods may pollute storage

An unusual condition at the Dalecarlia reservoir is the menace of polluted flood over-flow from Little Falls Branch. Residential developments and street paving on this watershed in recent years have caused such a concentration of water that the present tunnel under Brookmont Hill has insufficient capacity to carry off the flood water. The work on this item is planned for 1953.

Another item to safeguard the supply and insure uninterrupted water flow during floods and freezing weather is the construction of an intake and screen house to keep ice and debris from clogging the entrances of the two conduits at Great Falls. These works are proposed for 1956; the two facilities will cost about $879,000.

At the McMillan filtration plant and the nearby Bryant Street pumping station essential improvements are to be made. The basic filtering capacity of the McMillan plant will be increased from 100 to 125 mgd. by improving the piping and control systems and by enlarging and improving the chemical treatment facilities.

To secure the increased capacity at McMillan it is also necessary that the sedimentation facilities at the Georgetown reservoir be modernized and enlarged by 1950.

The Bryant Street pumping station,

built forty years ago, is in urgent need of modernization and a doubling of its pumping capacity. This station serves principally to pump the water produced by the McMillan plant to consumers in the three high-service areas but it will also be used to maintain proper pressures in the downtown low-service areas.

Improvement work at the Bryant Street station has a high priority. This and the work at McMillan and at the Georgetown reservoir are scheduled for completion in 1950 so that the McMillan system can take over an additional load when the output at the Dalecarlia plant may be reduced somewhat during construction work there. The cost of these facilities is estimated at $2,543,000.

To keep pace with developments in the large and growing area east of the Anacostia River, the existing auxiliary pumping station on Minnesota Avenue, S. E., even now too small for the desired purposes, will be completely revamped, enlarged and additional pumps installed to supply better service to the high areas of the Anacostia section. A somewhat similar course will be followed with the old auxiliary pumping station at Fort Reno. Here the construction of the new 40-mg. reservoir on the highest land in the District of Columbia will extend over the present station. The old station will be replaced by an electrically operated plant, which will supply only the Fourth High Service area. These two pumping stations are to be completed by 1952 at a cost of $661,000.

Terrain favors surface reservoirs

The hilly terrain of the District of Columbia and Arlington County, Va., lends itself ideally to the use of ground surface pure-water storage reservoirs for maintaining more uniform pressures in the service areas and for standby and reserve supplies of filtered water. While the reservoir system at present has only sufficient capacity to last about 12 hr. on a day of high consumption, such as occurred in July 1944, these together with the five additional ground surface reservoirs and one additional elevated tank proposed in the report will provide about 204 mg. storage.

This quantity is 91 percent of the future average day's consumption and 60 percent of the maximum day's consumption. This group of improvements will be completed in 1959 at an estimated cost of $4,523,000.

Ample provision for supply facilities would not help the consumer unless the pipe lines of the distribution system were extended or supplemented at the same time. Accordingly, about half the cost of the improvements covered in the comprehensive report are devoted to the distribution system and its appurtenances.

New cross-town trunk main

Principal addition to the system will be the construction of a large cross-town trunk main tying together the Dalecarlia and Bryant Street pumping stations over a route 7 mi. long. This interconnection of the two plants is essential for integrating and safeguarding the entire water system.

From the terminus of this cross-town main at First and N Sts., N. W., a large extension called the Southeast relief trunk main will be constructed to supply the area east of the Anacostia River, comprising $\frac{1}{3}$ of the entire District of Columbia.

Many other mains, both large and small, are planned for construction in all parts of the city as the need for them arises. Most of the distribution system improvements are to be completed by 1970 at an overall cost of $15,655,000.

With its widely separated facilities, including seven different water service areas, the water system will require many auxiliary facilities of a general nature which will to a large extent increase the operating efficiency of the system as a whole and of which the ultimate consumer is in no way aware. Among such facilities are additional telemetric transmission whereby the operators will be cognizant of field conditions and can coordinate such functions as rates of flow, water levels, pressures, and pumping requirements; spillage facilities to permit the controlled flow of water from higher to lower service areas in emergencies; equipment for the introduction of sterilizing agents apart from that at the filter plants in order to protect remote consumers and quickly erase local contamination from any cause; water meters; fire hydrants; shops and storehouses. These facilities will be installed as required over the entire period of the improvement program at an estimated cost of $3,684,000.

Planning ahead for 50 years can lead to many pitfalls. The problem is intricate and involved and requires intimate knowledge and sound study to envision and evaluate all of the numerous factors that must be taken into consideration. This has all been done in the comprehensive water report, which calls for a 43-year schedule of construction to be executed in four stages with estimated costs as follows: First, 1947-1950, $13,000,000; second, 1951-1955, $14,000,000; third, 1956-1961, $10,400,000; and fourth, 1962-1990, $4,000,000.

Special thought and emphasis was placed upon the financial aspects of the problem to provide the various facilities prior to the time they should be placed in service but at the same time hold the financial obligations at the lowest possible amount. Except for one year when an even $4,000,000 is required and two years when $3,000,000 is called for, all other annual needs range from $2,900,000 down to $2,000,000 in the earlier years and from $1,700,000 down to $60,000 annually in later years. These comparatively small capital investments in any one year for an improvement program of such a large waterworks system are intended to keep outstanding loan obligations always at the lowest possible figure.

Personnel

The Water Division, District of Columbia, and the Washington office of the Army Engineers worked together in producing the comprehensive report. Greeley and Hansen, consulting engineers of Chicago, reviewed and approved the plan.

Edwin A. Schmitt, head engineer, U. S. Engineer Office, supervised the general planning and preparation of the report. The Washington Aqueduct staff was represented by Maj. Dewey M. Radcliffe, chief of operations; Philip O. Macqueen, chief of the planning branch; Otto D. Voigt, planning engineer; and Carl J. Lauter, chemical engineer.

Acting for the District of Columbia were Harold A. Kemp, director of sanitary engineering, and the staff of the water division. This last group includes: Humphrey Beckett, superintendent; David V. Auld, assistant superintendent; Paul Lanham, engineer in charge of operations and maintenance; and Roy L. Orndorff, engineer of design and construction.

Sunken Steel Hopper Barge Cut to Pieces on the Bottom

W. L. Dickey
Lieut.-Comdr. Civil Engineer Corp,
U. S. Naval Reserve

***Contents in Brief**—Rough water and mud bottom combined to complicate removal of 750 tons of loaded barge that obstructed dredging operations. For underwater work a hydrogen torch was less effective than a combination of electric arc and oxygen jet in cutting steel covered with thick layers of rust and asphaltic-base paint.*

During excavation preparatory to construction of naval facilities on San Francisco Bay, a steel bottom-dump barge, loaded with rocky spoil, was accidentally sunk in a spot where dredging soon would have to be done. Loss of the barge was secondary to obstruction on the bay bottom. To delay the dredge meant delaying completion of a highly essential wartime project. The barge had settled quickly into a muddy bottom and 750 tons of steel and rocky spoil somehow had to be gotten out of the way.

An attempt was made to raise the barge by floats attached to the hulk but it was too firmly bedded in the mud and the attempt failed. The barge was an old one and so badly rusted that it was not thought possible to raise it by pumping air into the compartments even if the steel deck were repaired and strengthened. Demolition by dynamite could not be permitted because of proximity to structures, machinery and instruments in a nearby Navy yard.

Removal of the steel in sections, cut under water to a size that could be lifted by available equipment, was decided upon after careful study of the hulk by Jack Lewis, superintendent for Gerwick-Morrison-Twaits, the general contractors. As the barge, when empty, weighed about 450 tons, it obviously would have to be cut up to be lifted out, since no derrick barge was available with sufficient capacity to lift such a load bodily.

Barge cut to 90-ton sections

A survey of available floating equipment showed that lifts of about 90 tons would be feasible. The underwater cutting job was therefore laid out on the basis of first removing the material with which the barge had been loaded and then making four complete cuts entirely through the barge dividing it into five sections or lifts, each of which would be within the 90-ton lifting capacity.

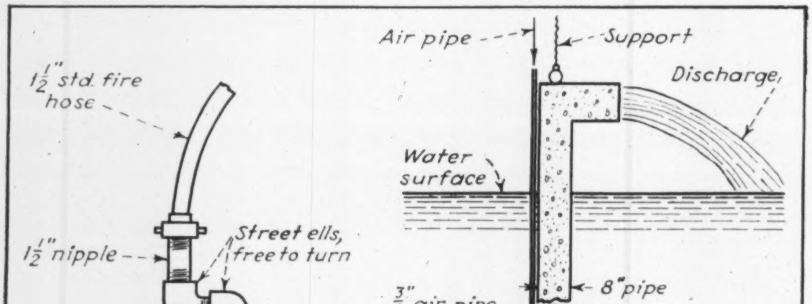


Fig. 1. A "no recoil" underwater jet was made with two nozzles in opposition to wash 75 tons of mud in sunken barge to an air-lift or "Portugee" pump.

The first step was to put buoy markers on the four corners of the barge. The hulk was found to be resting on an even keel but down by the stern, that is, the bow was 34 ft. below the surface and the stern 54 ft. Guided by these buoys the clamshell operator was able to remove about 75 percent of the 300 tons of rock and mud from the compartments. The remaining material was taken out with an air-lift or "Portugee" pump of the type shown in the accompanying illustration. This was operated by divers who worked the material to the pump intake with jets.

A very useful rig employed in this operation was the "no recoil" jet built for underwater use by Chester V. Womack, of the Womack Diving Service, San Francisco, by whom the underwater cutting was done. As indicated in Fig. 1, the two jets were connected to two elbows and a tee, which made it possible to turn the jets in either of two planes. By opposing the two jets the diver was relieved of the necessity for resisting recoil. This combination of jet and air lift satisfactorily removed the remaining 75 tons of the barge cargo.

The job of cutting the barge into sections was complicated by unusual factors. Tidal currents at the site are rapid, often reaching 7 and 8 knots, but due to the urgency of this project it was necessary to continue work regardless of tidal currents. For this reason much of the cutting was done from the inside of the barge.

In January and February, when this

work had to be done, San Francisco Bay has its roughest weather. One storm was so severe that the derrick barge, used as a diving float and on which were complete sets of diving gear and underwater burning outfits, was overturned and sunk.

Visibility in the water was practically nil. San Francisco Bay is usually muddy and on this job underwater operations were being carried on near the sunken barge by draglines, four clamshell dredges and three suction dredges. Hence the water was always extremely muddy.

Another difficulty was that the bottom of the barge had at some time been covered with a concrete lining 3 or 4 in. thick, increasing to a thickness of about 12 in. at the turn of the bilge. This concrete had to be removed before a cutting torch would be effective. A conventional type of air hammer operating a gad was used for breaking out the concrete, additional air pressure being supplied to compensate for the operation under water.

Rust and paint prove difficult

A still more serious handicap to cutting with a torch, however, was met in the heavy coatings of rust scale and bitumastic paint. The barge was quite old and had been repaired repeatedly by welding patch plates over damaged spots. In some places there were patches over patches. Under these conditions insulating layers of iron oxide were found sometimes as much as $\frac{3}{8}$ in. thick, sandwiched in between overlapping plates.

Subdividing the hulk into the sections planned necessitated cutting through these repair plates, whatever their thickness, through beams, bracings, bulkheads and even the 5-in. shafts of the dumping mechanism. Lifting holes and access ports also had to be cut.

Plates of single thickness were cut satisfactorily with a hydrogen and oxygen flame, burning in a bubble of compressed air, such as is frequently used for underwater cutting. However, where lapped plates were separated by layers of rust and paint it was desirable to find some more effective means of cutting. The thick rust layers insulated the metal from the heat of the hydrogen cutting flame and where asphaltic paints were encountered the hydrogen flame caused them to flow and shield the metal. These problems were met by Mr. Womack in the adaptation of a 350-amp., d.c. welding machine to the operation of an electric torch fed by an oxygen jet.

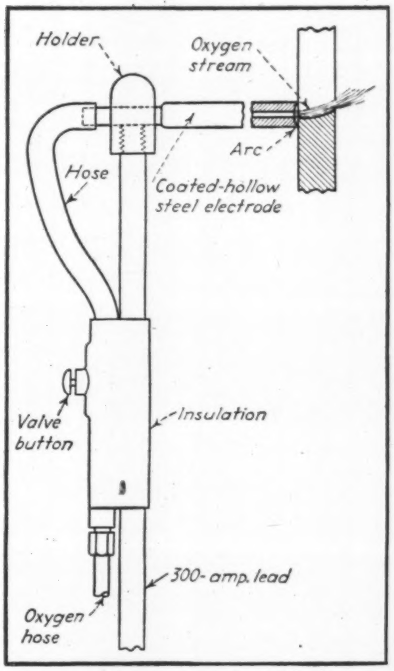


Fig. 2. Schematic sketch of the arc and oxygen combination that cut through insulation better than a hydrogen torch.

Oxygen fed to electric arc

As adapted by Mr. Womack this torch was made up around a piece of $\frac{1}{8}$-in. steel tubing wrapped, except for about an inch at one end, with three thicknesses of scotch masking tape. The unwrapped end could make good electrical contact in an electrode holder such as is used for electric welding. Oxygen was delivered through a rubber tube slipped over the short end of the steel tube projecting beyond the electrode holder. A valve in the oxygen line attached to the electrode holder controlled the flow of oxygen which was delivered at the same pressure used in oxyacetylene cutting plus whatever additional was needed to compensate for water pressure.

An arc was struck by touching the end of the wrapped steel tube to the metal to be cut. As the arc heated the metal, the blast of oxygen coming through the tube would cut the molten metal in the same manner as does the gas blast in an oxyacetylene cutting torch. The $\frac{1}{8}$-in. tube would burn off too, of course, but not too rapidly. It could be replaced almost as readily as an ordinary welding rod is inserted in a holder. This combination, which gave much better results than did the ordinary gas cutting torch, was used effectively for most of the cutting where heavy rust and thick paint layers covered the metal.

Diving suits were also adapted for use in the confined spaces of the sunken barge. The commercial type of suit, without the tying and lashing necessary on Navy types, was found more convenient. The helmets used were Navy type but were modified by transferring the air hose valve to the helmet where it was accessible and yet protected. Also, leads for the air hose and lifeline were changed from breastplate to belt at the diver's left side to give the diver better balance when crawling into and out of confined spaces.

Detail information on developments and costs of cutting with the arc-oxygen torch will be given in an article on underwater cutting and welding by Charles Kandel, to appear in the April 4 issue—Editor.

Peru Considers Building New Railroad to Iquitos

Steadily mounting interest in the economic and industrial possibilities of eastern Peru is exemplified by a bill recently submitted to the Peruvian Senate providing for the appointment of a commission of engineers to carry out studies for the construction of a railway from Cuzco northeast down the valley of the Urubamba and along the highlands east of the Ucayali River to Iquitos. The projected railway, according to reports received by the Transportation Department of the Office of Inter-American Affairs, would be about 600 mi. long and cost nearly $15,500,000.

At first glance, the idea of construction of such a railway may seem overly ambitious and extravagant at the present time. But it is well within the range of possibility that a comprehensive study of the area to be traversed by the projected line will reveal natural and exploitable resources far exceeding the initial cost. The new railway would tap regions believed to be rich in petroleum, rubber and gold, and known to be rich in timber, a vast variety of tropical products and large areas of colonizable land.

From Field and Office

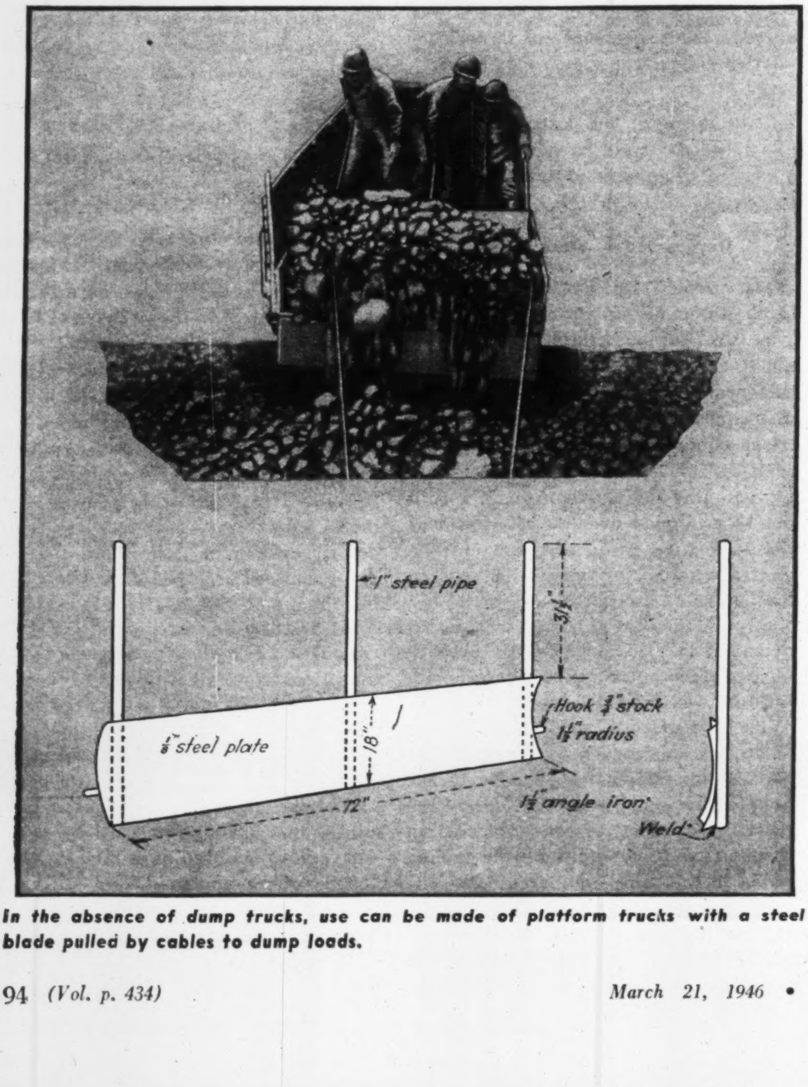
WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

How to Make a Platform Truck Into a Dump Truck

If you are caught short on dump trucks, and an ordinary platform truck is available it can be successfully used to accomplish the same purpose by constructing a 6-ft. blade as illustrated in the accompanying sketch.

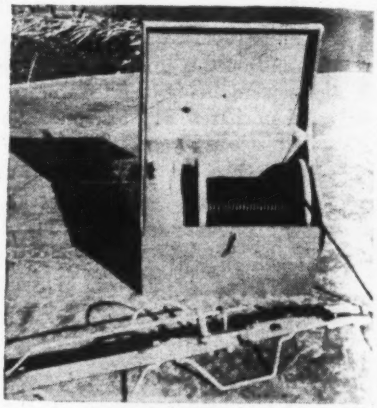
The operating procedure is simple. The blade is dug into load, similar to a hand shovel, and then pulled forward by cables attached to a tractor or other vehicle. As the blade clears the end of the truck, the towing vehicle is backed-up to slacken the cable. The procedure is repeated until the load is dumped. Usually it is not necessary to make more than two passes to complete the job.

If a towing vehicle is not available, the same results can be achieved by merely tying the cable to a stationary object and slowly moving the loaded truck forward.—Courtesy of *The Maintenance Engineer,* published by the Office of the Chief of Engineers.



In the absence of dump trucks, use can be made of platform trucks with a steel blade pulled by cables to dump loads.

Device for Locating Sewer Laterals



Simple spring-loaded device for locating sewer laterals and house service branches sounds alarm when opening is reached; locating element is designed for use with sectional sewer rods.

Designed primarily to locate house service branches or lateral sewers, but equally effective for locating broken sewers, an ingenious "finder" developed by Merle H. Clapper, waterworks superintendent at Delavan, Wis., eliminates much time-consuming and expensive digging. Main parts of the device are a patented element for use with sectional sewer rods, a coil of rubber-covered electrical cable and an alarm system.

The patented element, shown in the accompanying picture, consists of a wooden rod 2 in. square and 30 in. long, with two iron runners forming a sled-like base. Three spring-loaded locator arms—at both sides and top—are equipped with semi-circular projections to make the total diameter of the base element slightly greater than that of the sewer in which it is to be used. Electrical contacts on each of the three locator arms are arranged so that the circuit is normally broken, but is completed when one of the arms springs out.

In operation the finder is started in the sewer from a manhole, with the locator arms compressed. Sectional sewer rods are added as needed to push it along until one of the arms reaches an opening, causing contact to be made and an alarm to ring. Location of the opening is determined by the length of sewer rod used in pushing the finder to the opening.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Registration of Inspectors

Sir: After a careful review of W. D. Bigler's excellent article on the need of better inspection on construction, *ENR* Jan. 24, vol. p. 127, I was particularly impressed with the author's recommendation for legislation leading to the registration of inspectors.

Under the "New Definition of Engineering" as submitted for adoption by the several engineering organizations and as outlined in your article immediately following the one by Mr. Bigler, the term "Practice of Engineering" is fully defined and includes the item of supervision of construction "for the purpose of assuring compliance with specification and design. . . ." as one of the prerequisites of a "Professional Engineer".

It would appear logical to assume that if the proposed model registration law is approved by the governing boards of the several engineering organizations and found acceptable by the courts, an inspector on public or private buildings, etc., will come under the classification of a "Professional Engineer" and will require a license to perform such duties.

Whether this status of the inspector will then afford sufficient prestige to revise the contractor's estimate of his abilities as outlined by Mr. Bigler in the first part of his article, is still a question that is intimately related to the experience and personality of the inspector.

As an inspector of many years experience on both public and private construction, I have seen few instances of disagreement between contractors and inspectors that a fair attitude, coupled with sound judgment, could not eliminate. Naturally, there is no hope for agreement if an arbitrary attitude is assumed by either of these parties.

A capable inspector trained in the appropriate uses of engineering and architectural materials, keeping himself informed of the uses and characteristics of new materials as they are developed and having the ability to prepare the many necessary and often complicated reports on the progress and development of the work under his jurisdiction, would be far beyond criticism by the contractor as expressed in Mr. Bigler's article and he should expect and demand appropriate compensation for his abilities.

A. R. James

Bureau of Yards and Docks
U. S. Navy, Washington, D. C.

Limits on Truck Weights

Sir: We wish to call attention to an error which appeared in the Jan. 10 issue on pages 136 and 137, in the text of the article entitled "Progress Being Made Toward Uniformity in Truck Size and Weight Limits". In this article the statement was made (top of page 137) that, in the formula $W = C(L + 40)$ which is used to govern the allowable gross load on any group of consecutive axles, "Wyoming raised its upper coefficient to 850, the figure favored by the American Trucking Associations".

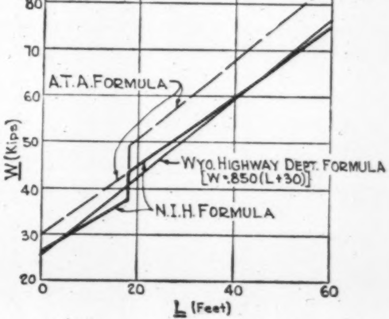
When revisions to the Wyoming motor vehicle law were under consideration by the 1945 session of the Wyoming Legislature, the Wyoming Highway Department did not favor the idea of using two gross weight formulas, one for axle groups under 18 ft. in length, and another for those over 18 ft. in length, as recommended by the National Interregional Highway Committee, thus permitting a sudden increase load of almost three tons for an axle group 18 ft. in length that would not be permitted for a group 17 ft. 11 in. in length. In order to avoid this sudden jump, and still follow the recommendations of the National Interregional Highway Committee as closely as possible, the Wyoming Highway Department sponsored the substitute formula: $W = 850(L + 30)$, to be used for all lengths of axle groups. This formula was adopted by the legislature, and is now part of the Wyoming motor vehicle law. While the coefficient 850 is used in this formula, you will note that the bracketed portion of the formula is $(L + 30)$, and not $(L + 40)$, which makes quite a difference.

The accompanying chart indicates clearly that the present Wyoming formula agrees quite closely with the recommendation of the Interregional Highway Committee, except that the above mentioned sudden jump at $L = 18$ ft. is avoided. At no point in the entire range of vehicle lengths does the Wyoming formula permit loads as great as those permitted by the formulas sponsored by the American Trucking Association.

We would appreciate having this letter, or its equivalent, appear in an early issue of *Engineering News-Record*, to correct misunderstandings.

J. R. Bromley,

Superintendent, Wyoming Highway Dept.



Permissible loads on axle groups under formulas favored by the American Trucking Associations, the National Interregional Highway Committee and the Wyoming Highway Department.

Radiant Heating For Sludge Digester Tanks

Sir: I read with interest (*ENR* Feb. 21, vol. p. 289) Mr. Wenzel's suggestion for applying the principles of radiant heating to sludge digestion tanks. The same idea occurred to me some time ago and was discussed with a representative of an organization interested in promoting radiant heating (Mr. Robert Law, Boston representative of A. M. Byers Co.).

In applying the principles of radiant heating to the heating of digesting sludge the following became apparent. First, in the usual tank design, especially for tanks with floating covers, sufficient radiating surface could not be obtained in the tank walls. Second, this would necessitate installing pipe within the tank floor to obtain sufficient radiating surface.

It is known that digested sludge has high insulating properties. As digested sludge settles to the tank bottom, the result is an insulating blanket of digested sludge over the floor. This would reduce considerably the amount of heat that could be transmitted to the digesting sludge from heating pipes encased in the digester floor, possibly to the extent of making the idea impracticable.

My computations were for heating digesters in Boston where wide variations in temperature prevail. It does seem that the radiant principles could be incorporated in sludge digesters in warmer climates, where sufficient heat could be supplied from pipe encased in the digester side walls, thereby reducing scum formation and avoiding costly maintenance on interior heating coils at the same time.

The indications are that sufficient heat cannot be supplied for heating sludge digesters by this method in the colder climates. I would not say, without further investigation, that the idea is inapplicable, but look forward to future publication of the results obtained from study and field research on this problem.

JOHN F. FLAHERTY
Asst. Engineer, Sewer Division
Boston Public Works Department

Acknowledgement of Credit

Sir: With reference to the correspondence in *ENR* Jan. 24, vol. p. 143, on the credit for producing labor-saving methods to be used in the design of continuous structures, it seems to me the basic point involved is whether the writer, whoever he may be, is concerned in offering help to his fellow engineers, or whether he is interested only in advertising his knowledge or pushing the sale of some publication for which he is responsible.

We all are indebted to others for most of the little knowledge we possess, and if because of some kindness of the gods, one of us has that little extra mathematical ability which enables him to initiate a new concept or derive a simplification of an existing one, surely he should not be attacked for offering freely of his knowledge for the benefit of others. If the writing of an article with such an object in view is to obligate the writer to give acknowledgement to all his sources of information, I suggest the matter might be covered by some such note as "with acknowledgement to all engineers, scientists and teachers from Galileo to the present".

To carry the idea to absurdity, if I give a member of my staff advice on design or detailing, am I expected to conclude with "acknowledgements to my instructors, various textbooks, magazine articles, and fellow engineers?"

HARRY B. DICKENS
Supervising Structural Engineer
Department of Public Works, Canada
Ottawa, Ontario

Active in South America

Following publication of "Latin America Pushes Construction Jobs", (*ENR* Feb. 7, 1946, vol. p. 209) additional information became available indicating the prominent role being played by the firm of Pardo, Proctor, Freeman & Mueser (Venezuela) in several major projects.

In Venezuela this firm is acting as engineers and designers for the $10,000,000 medical center at Caracas, on which construction contracts are held jointly by the George A. Fuller Co. and the Merritt, Chapman & Scott Corp. of New York City. Designs also have been prepared for a sanitorium at Barquisimeto, on which construction is expected to be started by the Fred Driscoll Co. and the Hegeman-Harris Co. of New York City.

In Brazil, Proctor, Freeman & Mueser (New York) designed the substructure for the Volta Redonda steel plant, which is to start operation this year. Prior to this, designs were completed for three large office buildings in Sao Paulo.—*Editor.*

Forecasting Floods

Sir: Richard Hazen (*ENR* Aug. 9, 1945) and E. E. Foster (*ENR* Sept. 20, 1945) have raised different questions in commenting on my article (*ENR* June 14, 1945).

I fully agree with Mr. Foster's conclusion that "the problem of flood frequencies can best be solved by frank and full acceptance of the theory of statistics". This argument eliminates the use of the purely empirical formulas proposed by Slade and Hazen. Furthermore, numerous applications have led to parabolic curves on Hazen's logarithmically normal probability paper instead of the straight lines foreseen by his method for the skew distribution of the flood.

Mr. Foster objects to the use of the plotting positions $(m - 1)/n$, and to Hazen's plotting position $(m - \frac{1}{2})/n$. However, no graphical method is possible without the choice of a plotting position. Finally, he objects to the use of the maximum flood, since this single flood is due to chance. Now, since all floods are due to chance, the omission of the maximum flood would deprive us of the most important information.

Mr. Foster rightly states the difference between floods and inundations. However, numerical calculations have shown that my method may also be used for inundations although with less security. In this case, unity for the return periods is the number of years divided by the number of inundations.

There is but one way to test the validity of forecasting. Divide a hundred years' record into two 50-year records, and forecast the second by the first. This procedure has given satisfactory results, if achieved through my method, for the few streams where such long records exist.

On this occasion I want to call attention to an omission in my article. The estimate of the constants by the method of moments need not lead to the best straight line on the probability paper. For this end, the classical method of least squares and the use of the reduced variates traced on a horizontal scale on the probability paper may be recommended.

E. J. GUMBEL
New School for Social Research
New York

Reverse Mileage

Sir: In the article on the International Bridge between Argentina and Brazil in your issue of Nov. 22, (vol. p. 692), you have two numbers reversed. Just in case anyone should call you on this, the distance from Buenos Aires to the bridge is 704 miles and from Rio de Janeiro to the bridge 1,412 miles. In your article they are reversed. Otherwise it's a swell piece.

ALBERT K. DAWSON,
Transportation Department
Office of Inter-American Affairs
Washington, D. C.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

STEEL PIPE LINE AND CONCRETE STRUCTURES PROVO RIVER PROJECT, UTAH

OWNER: Bureau of Reclamation, Provo Utah.

PROJECT: The construction and completion of four 70-inch inside diameter plate-steel pipe sections of the Salt Lake Aqueduct, Provo River Project, Utah, as follows: from station 457+16.42 to station 479+41.50, from station 1040+76.36 to station 1178+97.50, from station 1413+03.00 to station 1468+54.30, and from station 1613+03.00 to station 1634+01.30; and plate steel pipe for the Provo River crossing, station 374+95 to station 375+85. The work is situated between Provo and Salt Lake City, Utah. The greater part of the Salt Lake Aqueduct is to be constructed of concrete pipe. The sections covered by this bidding, however, will consist of plate-steel pipe, fabricated from plates of varying thicknesses and, except for the section at the Provo River crossing, placed to grade in trenches; provided with necessary manholes, blow-off piping, valves, anchors and concrete structures; and joined to the concrete pipe of the aqueduct. The plate steel pipe at the Provo River crossing will be a self-supporting span about 90 feet long, mounted in collars that will rest on existing concrete wall structures, and joined to the concrete pipe.

CONDITIONS: The Government is to furnish all plate steel pipe lengths, increasers, reducers and expansion joints, etc. All concrete other than the concrete required for the manufacture of precast-concrete pipe used in culverts and drainage crossings. The contractor is to furnish approximately all other material necessary for completion of the work. All work is to be completed within 210 calendar days, with delays resulting from the National Priorities System becoming effective subsequent to the bid date being considered as beyond the control of the contractor. Wage rates specified as minimum to be paid by the contractor are: Skilled labor, $1.50 to $1.75; semi-skilled, $1.00 to $1.25; common labor, 50¢ to 85¢ per hour.

BIDS: Five bids were received at Provo, Utah, December 27, 1945 ranging from $422,751.50 to $568,206.00.

LIST OF BIDDERS:

1. Carl B. Warren, Pleasant Grove, Utah	$422,751.50
2. R. A. Wattson, Hollywood, California	456,535.00
3. Utah Construction Co., Ogden, Utah	462,625.00
4. Gibbons & Reed Co., Salt Lake City, Utah	498,886.00
5. Tom L. Gogo, San Marino, California	568,206.00

		Unit Prices		
Item	Quan.	(1)	(2)	(3)
1. Excavation, common, for pipe trenches	123,000 cu. yds.	$.31	$.76	$.60
2. Excavation, rock, for pipe trenches	5,500 cu. yds.	1.18	6.50	3.00
3. Excavation, common, for structures	500 cu. yds.	2.04	1.75	2.50
4. Excavation, rock, for structures	50 cu. yds.	4.04	10.00	6.00
5. Excavation for drainage channels and dikes and for blowoff piping	1,000 cu. yds.	.28	1.40	1.00
6. Compacted embankment	1,500 cu. yds.	1.98	1.65	.60
7. Backfill	105,000 cu. yds.	.31	.52	.40
8. Compacting backfill	22,000 cu. yds.	1.74	1.85	1.50
9. Dry-rock paving	200 sq. yds.	4.84	4.00	5.00
10. Hauling, placing, field welding, coating and testing plate-steel pipe	Lump Sum	204,000.00	121,000.00	190,000.00
11. Overhaul of plate-steel pipe	10,000 ton-miles	.12	.35	.30
12. Concrete in structures	1,800 cu. yds.	48.50	37.50	40.00
13. Furnishing and placing reinforcement bars in structures	130,000 pounds	.09	.10	.09
14. Construction of 60-inch inside-diameter culvert	67 lin. ft.	29.50	15.00	25.00
15. Furnishing and installing miscellaneous metalwork	38,000 pounds	.35	.40	.25
16. Installing blowoff piping	20,000 pounds	.10	.20	.15
17. Installing valves	Lump Sum	385.00	750.00	2,000,000

◆

DRAINAGE CONDUIT, EAST BOSTON, MASS.

OWNER: Commonwealth of Massachusetts, Department of Public Works, Waterways Division.

PROJECT: Construction of a reinforced concrete drainage conduit between Porter St. and Prescott St., East Boston, at the General Edward Lawrence Logan Airport. Alternate proposals were received for reinforced concrete box and for 84 in. reinforced concrete pipe. Main difference between base bid and alternate bid (listed below) was that base bid required 3,312 cu.yds. of concrete and 236,160 pounds of reinf. steel, while alternate required but 1,046 cu.yds. concrete and 104,920 pounds reinf. steel. Alternant also required 1,492 lin. ft. precast pipe and support.

BIDS: Twelve bids received Nov. 27, 1945, ranging from the contract low of $172,216 to high of $347,136. (Estimated cost, $296,402.)

LIST OF BIDDERS:

	Alternate
1. C & R Construction Co., Boston, Mass.	$172,216
2. A. D. Daddario, Boston, Mass.	214,614
3. E. M. Matz, Boston, Mass.	224,077
4. R. Zoppo, Roslindale, Mass.	227,540
5. Marson Construction Co., Somerville, Mass.	237,194
6. B. Perini & Sons, Framingham, Mass.	256,679
7. V. Barletta Co., Roslindale, Mass.	287,690
8. M. DeMatteo Construction Co., Quincy, Mass.	296,325
9. Angelo Grande, Norwood, Mass.	300,766
10. Coleman Bros., Boston, Mass.	312,132
11. Federico Construction Co., Dedham, Mass.	341,179
12. J. F. Fitsgerald Construction Co., Boston, Mass.	347,136

		Unit Prices		
Item	Quan.	(1)	(2)	(3)
1. Trench	14,280 cu. yds.	$1.50	$3.25	$3.00
2. Excavation below grade	250 cu. yds.	1.50	3.00	4.00
3. Unclassified excavation	1,000 cu. yds.	.75	2.00	3.00
4. Channel excavation	6,000 cu. yds.	.50	.50	1.50
5. Boulder excavation	25 cu. yds.	10.00	10.00	20.00
6. Foundation piles	28,200 lin. ft.	.50	.90	.75
7. Bulkhead piles	720 lin. ft.	2.00	3.00	2.50
8. Lumber left in place	125 M. b. m.	260.00	150.00	200.00
9. Screened gravel	1,400 tons	1.60	2.00	2.50
10. 10″ underdrain	2,400 lin. ft.	.80	1.00	1.00
11. Ordinary borrow	26,000 cu. yds.	1.40	.75	1.00
12. Concrete	1,046 cu. yds.	12.50	15.00	18.00
13 Concrete heated	500 cu. yds.	12.75	15.00	20.00
14. Reinforcing steel	104,920 pounds	.047	.07	.06
15. Fastenings	2,500 pounds	.10	.30	.40
16. Manholes	10 each	200.00	150.00	200.00
16. 18″ D. S. V. C. pipe stubs	8 each	10.00	15.00	5.00
18. Drilling holes	30 lin. ft.	3.00	1.00	4.00
19. Cutting slots	60 lin. ft.	3.00	1.00	6.00
20. Cleaning B. & A. R. R. drain	Lump Sum	1,000.00	6,000.00	1,500.00
21. Precast pipe and support	1,492 lin. ft.	20.00	35.00	32.00

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Power Truck

Adapted from the four-wheel drive Dodge military vehicle, the new "Power Wagon" truck has many peacetime construction applications. This sturdy, four-wheel-drive, general purpose truck has 94-hp. engine, four-speed transmission, two-speed transfer case, closed cab, steel express body 8 x 4½ ft. and 22¼ in. high. This body has special reinforced stake pockets, double-drop frame with side rail reinforcements, 126-in. wheelbase and choice of 9.00/16 or 7.50/16 eight-ply tires.

A dual-power takeoff is said to deliver 536 rpm. at the tailshaft to operate many types of machinery or drive a 9-in. dia. belt pulley drive at a speed of 3,124 ft. per min.; this takeoff will also operate a front-mounted power winch of 7,500-lb. capacity.—*Dodge Division of Chrysler Corp. 7900 Joseph Campau, Detroit, 11, Mich.*

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Cable Tester and Locator

A new cable tester and locator is said to tell just where cable or pipe is buried, and how deep. It finds old cable or pipe on which installation records have been lost or forgotten and locates the path of cable or pipe. The uses of this instrument cover the needs of industrial concerns, public utilities and contractors.

The unit is strong, portable and compactly encased for rough use and weather. Size: 12½" x 7¼" x 11" high. Weight: approximately 22 lbs.—*W. C. Dillon & Co., 5410 W. Harrison Street, Chicago 44, Ill.*

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Light-Weight Generator

Designed as a portable power source for electric tools, floodlights, amplifying, etc., a new generator unit is good for emergency power when power lines are inaccessible. The 1,800-watt, 115-volt A.C. generator weighs only 115 lbs. Overall dimensions are 22⅜ x 17⅛ x 21⅛ in. The single-cylinder, air-cooled, 2-cycle engine has only one valve, a rotary disc type which is self-seating and requires no adjustment. An improved magneto gives a strong spark for easy starting.—*Homelite Corp., Port Chester, N. Y.*

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Hypersonic Analyzer

A hypersonic analyzer, said to be able to detect any change in density of a wide variety of materials, has definite possibilities in the metals and plastic fields. The method developed is particularly applicable to materials having a constant cross section such as those obtained by rolling and extruding.

In the rolling of sheet steel, for example, the analyzer will detect and identify accurately the location of pipes, cat's eyes, blisters and laminations, early in the manufacturing process, thus making possible appreciable savings in time and money expended on finishing.—*The Brush Development Co., 3311 Perkins Ave., Cleveland 14, Ohio.*

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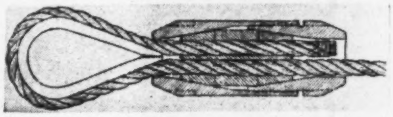
Wire Rope Clamp

It is claimed that a new wire rope clamp incorporates a new wedging action in its component parts, making it possible to hold loads in excess of the tensile strength of the rope used. The unit is alloy steel, cadmium plated for weather protection, streamlined for neat appearance and freedom from obstruction. It is easily assembled by unskilled labor and may be readily disassembled for the tightening of stretched lines or other uses. It is made in all standard sizes from 1/16 in to ¾ in.



Every industry in which wire rope is used for hoisting, hauling, drilling, guying, control cables, etc., should find this clamp of use.—*Nunn Manufacturing Co., Evanston, Ill.*

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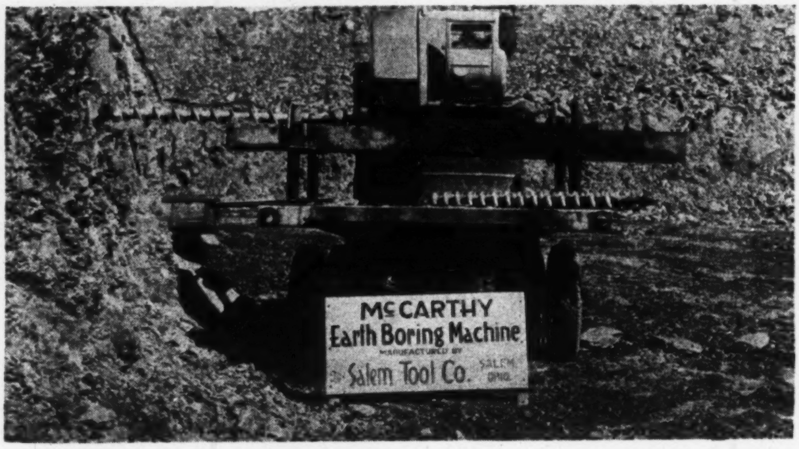
Electrode for Cast Iron

"Harcast," an all-position mild steel electrode for welding and repairing cast iron, fuses well with either mild or medium carbon steel. With a yield point of 50,000 lb. psi., the deposited metal is said to have an ultimate tensile strength of 60,000 lb.

Usable with either AC or DC machines (straight or reverse polarity on DC), "Harcast" works well at low amperage, thus minimizing the dilution effect at the fusion zone. Reverse polarity on DC



Earth Boring Machine

A new horizontal earth boring machine, known as the McCarthy drill, has been designed for strip mine drilling. The hydraulic unit feeds the augers, eliminating all manual feeding and enabling faster drilling. The operator can raise the machine as much as 4 ft. from the ground or truck bed with the new type jacks. The drill is furnished in truck mounted, trailer mounted, self-propelled horizontal and vertical types.—*Salem Tool Co., Salem, Ohio.*

throughout the
CONSTRUCTION field...

M·S·A Skullgard

"The Hat That Takes Care of Their Heads"

Wherever overhead hazards threaten the safety of men employed on construction projects, M.S.A. Skullgards—most popular work hats in the field—provide proved protection and outstanding wearing ease. These famous Hats present tremendous resistance to impact, with their great strength developed through exclusive, *high-pressure molded* laminated bakelite material. Hard, dense and smooth finished, Skullgards cannot deteriorate through exposure to the elements, common chemicals, grease or perspiration. They take hard knocks while furnishing easy fitting, well-balanced, ventilated comfort for the heads of hundreds of thousands of American workmen. You can't go wrong when you specify the favorite work hat of them all—M.S.A. Skullgard!

Write for Bulletin DK-11.

FEATURES

- **High-Pressure Molded Laminated Bakelite**
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- **Cannot Soften, Swell or Gain in Weight**
- **High Dielectric Strength**
- **Natural Ventilation**
- **7 Popular Types**

MINE SAFETY APPLIANCES CO.
BRADDOCK, THOMAS AND MEADE STREETS
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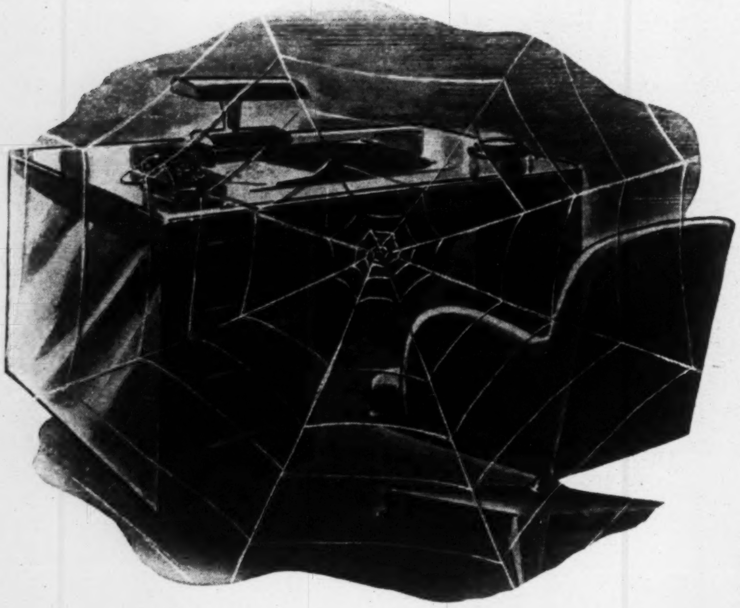

The man we have never met

This man is a disgruntled client. Within the scope of our thirty years of construction experience we have completed thousands of important public and private projects involving the expenditure of many millions of dollars. Not one default blots our record. We work diligently with technical skill to fuse the plans, ideas and ideals of architect, owner and contractor. This harmony in cooperation is productive. The job is finished on schedule. The joy of achievement is shared mutually. It is our belief this policy will keep the man above out of our path—and yours—forever.

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WE BUILD TO YOUR DESIGN

current produces a smooth bead with deep penetration. On DC straight polarity, penetration is less, higher beads are built, and there is less spread in the fusion zone.—*Harnischfeger Corp., Welding Division, Milwaukee 14, Wis.*

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Waterproof Liquid Adds Portland Cement

Addition of portland cement to "Seallock," a waterproof liquid in use for five years, is said to add to the durability and possible applications of this product. It may be brushed on moistened surfaces of many kinds, above and below ground, inside and out.—*The Seallock Co., 6 Northview Place, White Plains, N. Y.*

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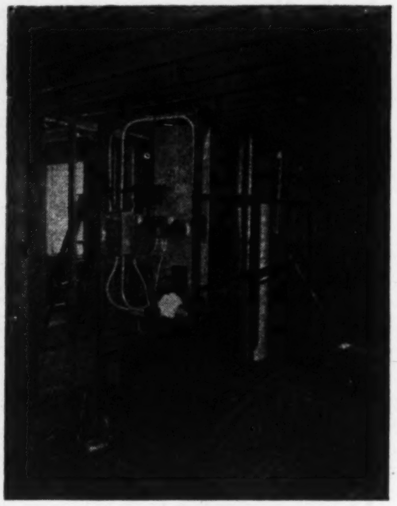


Utility Unit

Inside this frame, 30 in. wide by 90 in. long by 77 in. high are electrical distribution and control boxes, specially designed oil or gas furnace with automatic controls, air filter and blower, and water heater. The Ingersoll utility unit includes complete kitchen, laundry and bathroom fixtures and appliances.—*Trade Development Corp., 135 S. LaSalle Street, Chicago 3, Ill.*

• • •

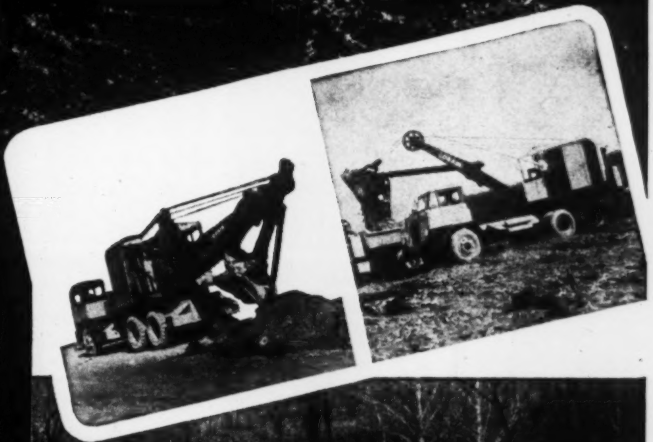
Carbon Electrode Holder

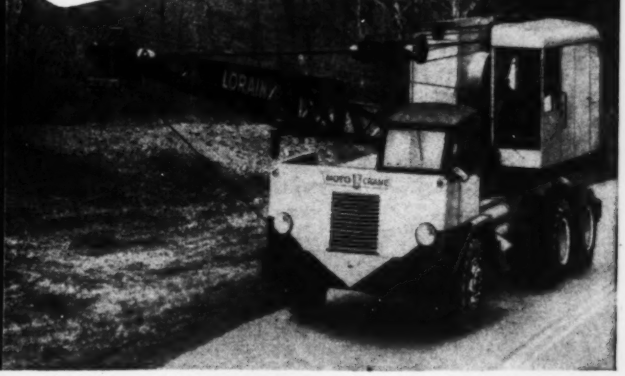
A new line of air cooled carbon electrode holders for manual welding has been announced. The line includes four sizes, 150, 200, 300, and 500-ampere models.

The average carbon arc welding job is done with either the 13½-oz. 150-ampere holder or the 20-oz. 200-ampere unit. The 300 and 500-ampere models are suitable for heavy welding and cutting jobs.—*Tweco Products Co., Wichita 1, Kan.*

THIS UNIT REALLY

GOES PLACES AND DOES THINGS





Speed is an outstanding feature of the new, powerful postwar Lorain Moto-Crane.

Speed in getting from job to job—up to 31 m. p. h. on hard surfaces—and remarkable soft-ground flotation for covering territory off the road.

Speed, too, when it's on the job excavating with clamshell or shovel, trenching with hoe, tossing a dragline, or handling materials with crane hook.

These fast, agile, rubber-tired Lorain Moto-Cranes also have greater capacity for bigger payloads and increased stability for long boom, wide radius swing.

Lorain Moto-Cranes are six wheel units with 4 or 6-wheel drive. See them in action, and let your nearest Lorain distributor explain their many other profit-making features.

GET THE FACTS and YOU'LL GET A...

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The trend to More Power and Bigger Trucks

In both over-the-highway and off-the-highway service, the trend is to larger units to assure increased payloads at *easily maintained*, high average road speeds. The Fuller Model 5A920 is the *only* automotive transmission which is designed to handle these big new engines in the extra-tough operations . . . and which has proved itself in service. Here's another example of why alert truck owners specify Fuller Transmissions.

FULLER MANUFACTURING COMPANY, TRANSMISSION DIVISION
KALAMAZOO 13F, MICHIGAN
Unit Drop Forge Division, Milwaukee 1, Wisconsin

Where Accuracy and Dependability Count!

Use THE WHITE TRANSIT

Built to rigid specifications—featuring coated optics—here is a truly fine instrument providing the utmost in versatility and dependability. Designed particularly for Municipal, Railroad, Highway and Bridge work.

Write today for full information and prices on the White Type II Transit.

305 W. COURT ST., MILWAUKEE 12, WISCONSIN

DAVID WHITE COMPANY

Manufacturers of Instruments for Engineers, Surveyors and Builders.

Manufacturers' Activities

J. W. Simpson, vice-president in charge of sales for the Mueller Co., Decatur, Ill. was recently honored at a gathering of company employees. The occasion was in recognition of his 45 years in the service of the company. Mr. Simpson was presented with a 45-year pin by W. E. Mueller, president of the firm.

Mr. Simpson, who is widely known in the water, gas and plumbing field, began his long service to the Mueller Co. in 1899. His first job was as messenger boy. He was successively advanced through the various departments, and in 1916 was serving as assistant to the president. The following year he was made sales manager and subsequently was elected to the vice-presidency. Since 1917 he has guided the the sales division through two wars and a depression. Today finds him vigorously attacking present sales problems with all of his early enthusiasm. Mr. Simpson has seen the firm expand from one small plant in Decatur to six large ones—including branches in Chattanooga, Los Angeles, and Sarnia, Ont.

The Board of directors of Moretrench Corp., Rockaway, N. J., has announced the election of the following officers:

President, Edward J. Moore, formerly vice-president, headquarters, Rockaway, N. J.; vice-presidents—Paul J. Jones, in charge of eastern sales division, headquarters, New York City.; Lawrence G. Kelley, in charge of Mid-West sales division, headquarters, Chicago, Ill.; Sanford P. Edgar, in charge of Southern sales division, including the branch office recently opened in Tampa, Fla., headquarters, Houston, Tex.; Thomas C. Gill, chief engineer in charge of construction engineering, headquarters, New York City; Edwin B. Singleton, in charge of manufacturing, and superintendent of all plants, headquarters, Rockaway, N. J.

All of the above have been with the Moretrench Corp. for many years and have helped develop wellpoint equip-

ONE PLACE TO LOWER OVERHEAD IS...

...*Underfoot*

There's a lot of unnecessary money spent on some floors because one fundamental fact is overlooked: *that excessive wear and mechanical failure are frequently induced by decay.* Halt the decay—and the floor lasts.

In one large warehouse, four years of service left the original floor in such bad condition that a new one was necessary. Pressure-treated wood was used for the replacement . . . and after 12 years it was still good, with no indication that the end of its usefulness was anywhere in sight.

The decay hazard is greater when moisture is present, and here pressure-treated wood pays extra dividends. The high degree of protection that pressure-treatment gives under these conditions has been demonstrated many times over, under all types of service.

For floors, platforms or other structural members exposed to chemical attack, Koppers has developed a new plastic impregnated wood you will find it worthwhile to investigate. Ask for the facts about "Asidbar."*

Our illustrated bulletin, "Economical and Permanent Construction with Pressure-Treated Wood" will give you timely information. We will gladly send a copy, on request. Wood Preserving Division, Koppers Company, Inc., Pittsburgh 19, Pennsylvania.

*Trademark

WOOD PRESERVING DIVISION

KOPPERS

The Industry that Serves all Industry

TANKS
BUILDINGS
CULVERTS
BRIDGES
PILING
DOCKS

RB&W CAP SCREWS

FIT FOR REFINED COMPANY

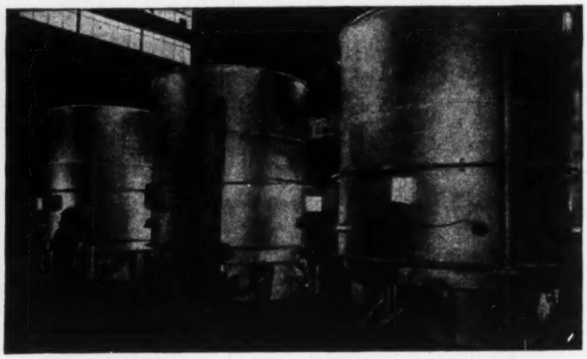
RB&W
7/16
3
RB&W
1/2
1

Furnished Bright or Hi-Carb Heat Treated, RB&W Cap Screws give your product maximum fastener strength and finest appearance . . . and they are held to close tolerances that just a few short years ago were considered impossible for a commercial product.

Uniform physical properties are assured by scientific selection and preparation of raw material, use of the latest type of modern equipment and a system of quality control followed throughout production.

COMPLETE RANGE RB&W Cap Screws are produced in a size range up to 1" x 8" and are stocked through 1" x 6" in Bright and $\frac{3}{4}$" in Hi-Carb Heat Treated. The Heat Treated screws have a black, satin-lustre finish obtained by a special RB&W process.

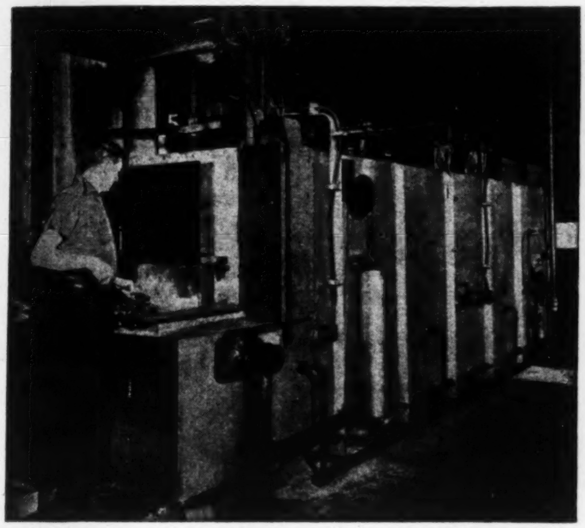
QUALITY CONTROL — Mechanical and physical examination of raw material plus continuous inspection at every stage of manufacture provide assurance of uniformity and top quality.



PREPARATION — Hi-carbon and alloy steels are prepared for cold-forming in these spheroidizing furnaces, which improve the microstructure of the material.

PRODUCTION — Impressive tonnage output daily comes from this battery of machines, representing only a fraction of RB&W Cap Screw manufacturing capacity.

LARGEST MACHINES — These machines have capacity for producing Cap Screws cold up to 1" diameter and offer maximum attainment in close tolerance work.



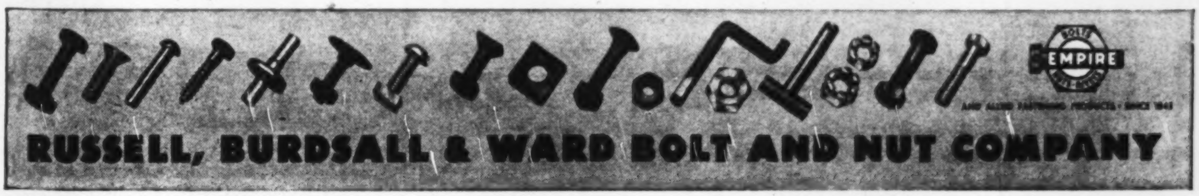
UNIFORM TREATMENT — All RB&W Hi-Carb Cap Screws are hardened in atmospheric-controlled furnaces. A very close automatic temperature control and other features provide uniform and thorough heating, with complete freedom from scale.

TEMPERING — After oil quenching, RB&W Hi-Carb screws are tempered in batch type draw furnaces. The final step is the application of the special satin finish which distinguishes this high strength product.

RB&W The complete quality line

101 YEARS *Making strong the things that make America strong*

Plants at: Port Chester, N. Y., Coraopolis, Pa., Rock Falls, Ill. *Sales Offices at:* Philadelphia, Chicago, Chattanooga, Los Angeles, Portland, Seattle. *Distributors* from coast to coast. By ordering through your distributor, you can get prompt service for your normal needs from his stocks. Also, the industry's most complete, easiest-to-use catalog.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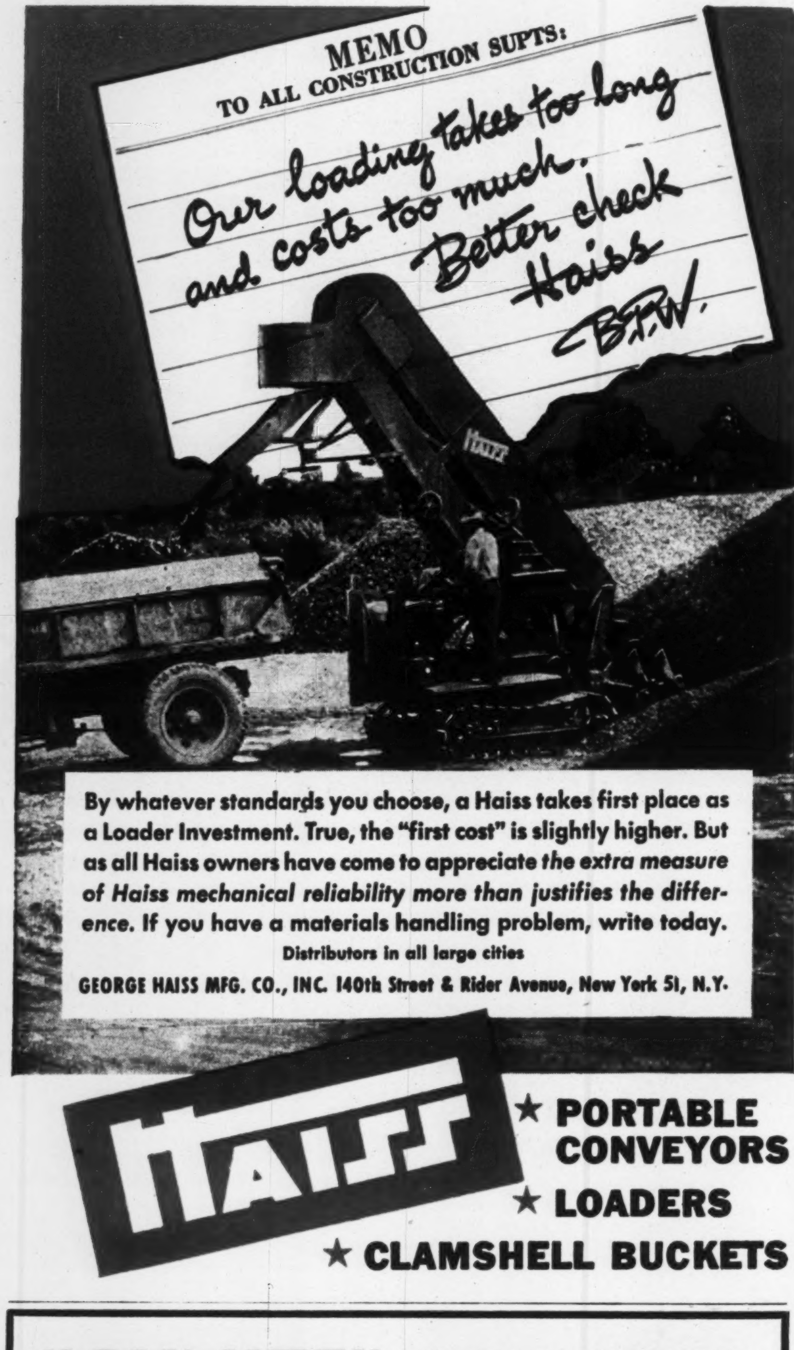
AND ALLIED FASTENING PRODUCTS • SINCE 1845
RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY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Our loading takes too long and costs too much. Better check Haiss
B.P.W.
HAISS

By whatever standards you choose, a Haiss takes first place as a Loader Investment. True, the "first cost" is slightly higher. But as all Haiss owners have come to appreciate *the extra measure of Haiss mechanical reliability more than justifies the difference. If you have a materials handling problem, write today.*

Distributors in all large cities

GEORGE HAISS MFG. CO., INC. 140th Street & Rider Avenue, New York 51, N.Y.

HAISS ★ PORTABLE CONVEYORS ★ LOADERS ★ CLAMSHELL BUCKETS

"GUNITE" CONCRETE

For ● Steel Plate Lining ● Steel Encasement ● Building Walls, Roofs, Facings ● Tunnel Lining ● Water Reservoir Lining ● Power Plants — Bunker Lining ● Sewer Repairs ● Tank Lining ● Canal and Ditch Lining ● Repairs of Disintegrated Concrete, Brick, Tile, Masonry

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DISTRICT BRANCH OFFICE: 228 N. LaSalle Street, CHICAGO 1, ILL.
BRANCH OFFICES: ST. LOUIS • DENVER • DALLAS • HOUSTON • NEW ORLEANS

ment and its use in predraining wet foundation excavation.

EUGENE E. GLOSS has been designated as service manager of ball bearings, New Departure division of General Motors. He succeeds Harold R. Goodale who has gone into private business. Mr. Gloss was service consultant for New Departure for seven years when in February, 1942, he became deputy chief, and later chief, of the bearings branch in the War Production Board. In December, 1944, he was loaned to the FEA as consultant to the U. S. and British Legations in Stockholm. Later he was confidential investigator for the U. S. Government with FEA to investigate the German bearing industry, and served until October, 1945, with the simulated rank of colonel, U.S.A.

THE PACIFIC CHAIN & MANUFACTURING Co. has purchased the former Kaiser Co. sub-assembly plant at The Dalles, Ore., from the U. S. Maritime Commission and is dismantling it for re-erection as its new Portland plant. The dismantling is being supervised by Don. S. Burnett, chief engineer.

FIFTY-SEVEN exclusive distributors now comprise the domestic sales organization of R. G. LeTourneau, Inc., Peoria, Ill. Providing sales, service and parts facilities, the distributing firms serve earthmoving and construction users throughout the United States and Canada, with representation in 91 cities.

"Our newly completed organization of exclusive distributors assures this firm a promising future, having already produced sufficient business to keep all of our domestic and export plants in full production through 1946," asserts G. S. McKenty, LeTourneau general sales manager.

W. G. TURNER, who was a captain in the armed forces for more than three years, has been reinstated as service and sales branch manager at San Francisco, for Timken Roller Bearing Co., Canton, Ohio, which he joined in May, 1934. F. A. Weiseberger has been transferred from San Francisco to Pittsburgh to become branch manager; while T. F. Rose goes from Pittsburgh to Cincinnati where he replaces L. W. Mckelvy, resigned, as branch manager.

A. C. CARPENTER, first vice-president, and A. V. Phillips, second vice-president of the Bemis Bro. Bag Co., St. Louis, Mo., are retiring as officers after 49 and 54 years of service respectively. They will continue as directors and senior counselors. Mr. Carpenter started as superintendent at the bag factory at New Orleans and later became manager there and at St. Louis. He was first elected a

K . . . is for the knockout power

in Sullivan Paving Breakers

K 81... heavy weight

● Here's the paving breaker that will handle your toughest concrete demolition jobs — economically and efficiently. It breaks more concrete because it strikes more and heavier blows and because the operators find it easier to handle. Outstanding features of the K-81 include the exclusive Sullivan "Dual Valve," flat-sided cylinder for easy holding against operator's leg, replaceable chuck bushings, "U" type side rods and rugged cam-type retainer.

The Thrifty Sullivan DUAL VALVE
Makes Air Do More Work!

K 61... medium weight

● This is the "younger brother" of the K-81 and is specially suited for thin section concrete and other light demolition jobs. It has the same hard-hitting, easy-handling characteristics but it is lighter in weight. Many of the parts, such as the interchangeable chuck housing, renewable chuck bushing and throttle, will fit both the K-61 and K-81 — which means a considerable saving in repair parts stock.

K9.. light weight

● The K-9 is relatively small but is still a powerful breaker that is easy to handle. Its light weight makes it particularly useful in tunnel, trench or overhead work. Its low air consumption is a big advantage where air supply is limited.

Get the facts about these three paving breakers today. See your nearest Sullivan office or write for bulletins. **Sullivan Machinery Company, Michigan City, Indiana. In Canada: Canadian Sullivan Machinery Co., Ltd., Dundas Ontario.**

PRODUCTS
Portable Compressors • Stationary Compressors • Rock Drills • Wagon Drills • Core Drills • Portable Hoists • Paving Breakers • Trench Diggers • Sheeting Drivers • and other Pneumatic Tools

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Huntington • Knoxville • Los Angeles • Middlesboro • New York • Philadelphia • Pittsburgh •
Portland • Salt Lake City • San Francisco • Seattle • Spokane • St. Louis • Washington, D. C.

director in 1920 and vice-president in 1923. Mr. Phillips began with the company as an accountant in St. Louis. For many years he was in charge of burlap purchasing in Boston and during the twenties he was in India, directing an affiliated jute mill. He was first elected a director and vice-president in 1911.

The Buffalo-Springfield Roller Co., Springfield, Ohio, has announced the promotion of J. F. Harrison, chief engineer and works manager, to vice-president in charge of engineering and manufacturing. Mr. Harrison, who has been in the engineering field for more than 23 years, has been associated with the pioneering of many new developments in the construction equipment industry. Prior to joining Buffalo-Springfield in 1941, he was associated in engineering capacities with other construction equipment manufacturers.

The Shafer Bearing Corp. of Chicago has appointed Maj. O. W. Schmidt as national sales manager. He will be responsible for the development and maintenance of a field organization to supplement the sales-promotional efforts of Shafer representatives and distributors. An engineering graduate of Iowa State College, Major Schmidt became a sales engineer for a large machinery and supply company. In 1942, he became assistant chief of the Production Division, Central District, of the Air Technical Service Command, Army Air Forces.

P & F Corbin division, American Hardware Corp., New Britain, Conn., has announced the appointment of John A. Metz as Chicago district sales manager. Mr. Metz joined Corbin in 1923 after several years with the Cobb Whyte & Laemmer Co., hardware specialists of Chicago. Assigned to the Chicago district office, Mr. Metz first represented the firm in Illinois, Indiana and Kentucky, later being transferred to the Chicago metropolitan area. Beginning six years ago, Mr. Metz served as sales representative in parts of Iowa, Missouri and Wyoming, and all of Nebraska and Colorado, until his present promotion.

Neil S. Lincoln has been named sales manager of the Automotive Division of the Timken-Detroit Axle Co., according to an announcement by Ralph H. Trese, vice president. Mr. Lincoln, a veteran of many years in the automotive industry, joined Timken in 1942. Other changes include: C. C. Bartell named sales manager of special equipment division; H. C. Maddux, sales manager of the trailer division; E. E. Weiss, assistant sales manager of the bus division.

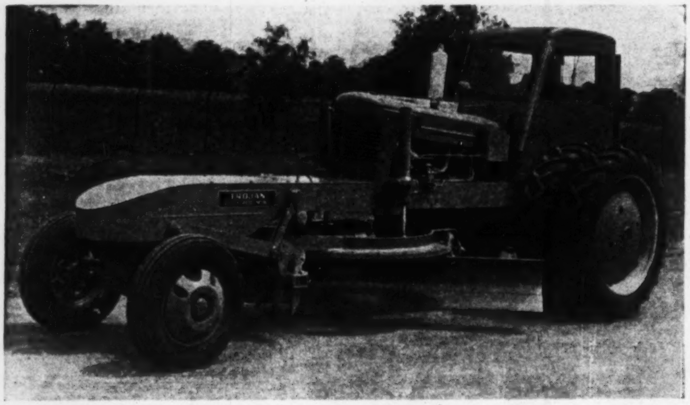
C. L. Hardy has been appointed manager of the Philadelphia Steel-Service Plant of Joseph T. Ryerson & Son, Inc. He succeeds James M. Mead, who becomes manager of the Ryerson plant in New York City.

Five Additions to the executive personnel of Ellinwood Industries, Los Angeles, Calif., have been announced by President Ray Ellinwood. H. R. Edwards has been named regional sales manager, Eastern Region, Farm Equipment Division; George Kis, electronics laboratory technician; M. C. Nelson, supervisor of the Hydraulic Research Laboratory; Albert Rebel, export sales manager of the Farm Equipment Division, and Edward M. Sumner, electronics laboratory research director.

The Carboloy Co., Inc., announces it has completed expansion and streamlining of its factory sales organization in Detroit, Mich. Headed by K. R. Beardslee, vice president in charge of sales, the Carboloy sales department is now divided into several sections, each being assigned responsibility for a general class of carbide used, or a specific method of marketing.

After 44 years of service, H. R. Hausman, vice-president and assistant general manager of the Lehigh Portland Cement Co., Allentown, Pa., has retired. To succeed him, Roy N. Young has been elected vice-president and operating manager.

TROJAN



Rugged, thrifty and powerful are the reasons why Municipalities choose this machine for year around jobs. Stepped up power combined with over all economy puts the Trojan Utility Speed Patrol out in front.

Write today for literature and specifications.

CONTRACTORS MACHINERY CO. INC.
DEPT. NR 61 BATAVIA, N. Y.

See your International Industrial Distributor

Elections and Activities

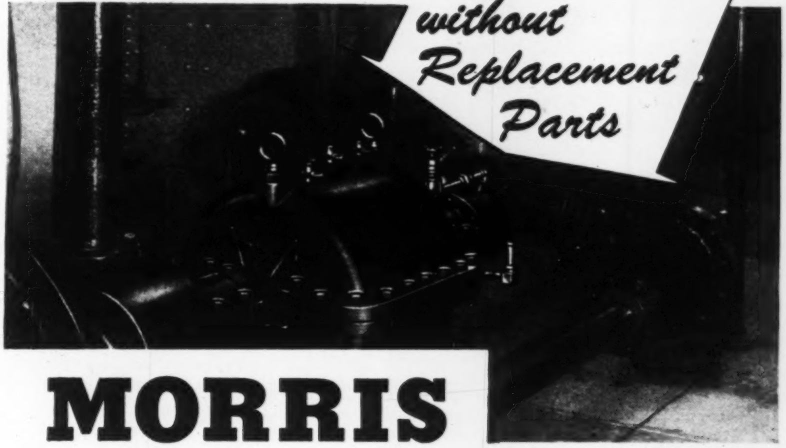
The New York section of the Sewage Works Association, whose meeting was held in New York recently, heard Carl Wolf, executive secretary of the American Gas Association, say that in order to implement the well-made plans for postwar work in the waterworks field through adequate planning it will be necessary to think of promoting the product and bringing to the consumer's attention the more efficient and beneficial service that waterworks operators can render with these improvements. As an example of what may be done, he called attention to recent developments in the gas industry, where $4 million has been made available to the American Gas Association for fundamental research in production, distribution and utilization of their product.

"In addition," said Mr. Wolf, "as a requisite to survival, business, both large and small, must not have undue government competition—government must cooperate with and augment industry, not compete with it. And no one group, be it government, labor or industry, should be permitted to gain dominance over our economy. Small business should be protected and encouraged."

Ohio Section, American Waterworks Association, has elected Luther T. Fawcett of Youngstown, chief engineer of the Mahoning Valley Sanitary District, chairman, with C. B. Cook, Painesville, Lake County sanitary engineer, vice chairman; and F. P. Fisher, representative of the Wallace & Tiernan Co., Cleveland, secretary.

M. S. Campbell of the H. D. Fowler Co. has been elected president of the Seattle section, American Society of Civil Engineers. E. B. Crane, principal assistant engineer in the Seattle office of the Chicago, Milwaukee, St. Paul & Pacific Railroad, is vice-president and E. C. Jensen, chief engineer for the Washington state department of health, is secretary-treasurer.

The following new officers have been elected by the Dallas, Tex., Chapter of the Associated General Contractors: George Dolph, president; W. L. Hickey, vice-president; H. H. Meers, secretary-treasurer; and Cedric Burgher, S. J. Churchill, J. O. Boyd, A. R. Eckert, D. F.



ALMOST A QUARTER OF A CENTURY *without Replacement Parts*

MORRIS *Centrifugal* PUMP

In Busy Department Store ELEVATOR SERVICE Turns in Impressive Record Of Long Life

● Elevator Service in the Sage-Allen Company department store of Hartford, Conn., is heavy and continuous six days a week. Top pressures in the hydraulic operating system are around 125 lbs. It takes nearly 400 GPM to keep all elevators going.

Those are the specifications to which this 3-stage, horizontally split, bronze fitted MORRIS CENTRIFUGAL PUMP was built almost a quarter of a century ago. With a direct-connected 60 HP. motor, turning at 1800 RPM., it has been in service now for 24 years. Only within recent weeks have replacement parts been necessary.

MORRIS PUMPS BUILT FOR SERVICE OVER THE YEARS

A quarter of a century of efficient and economical pump service is a far cry from the theoretical 10 years which some people say are the limit of useful pump design. But Morris engineers refuse to believe that any good pump, or pump design, is obsolete so long as it does the work, does it efficiently, and does it economically. Every Morris pump is built to last . . . built to give maximum satisfactory service at a lower cost over the years.

●

Let Morris engineers — with more than 75 years of pump design and operating data to draw on — recommend the correct pump for your needs. No charge. No obligation.

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MORRIS MACHINE WORKS
BALDWINSVILLE, N. Y.
Branch Offices in Principal Cities

MORRIS CENTRIFUGAL PUMPS

WHAT A WALLOP!

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100%
SELF-CONTAINED
PORTABLE
PAVING
BREAKERS
Gasoline Hammers

The explosive energy of gasoline—producing 2,000 heavy, powerful blows per minute of a free-floating piston—make short work of busting concrete—cutting asphalt—digging in clay, shale and frozen ground—tamping—and a host of other jobs.

Write for full particulars

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OR HOSE
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SYNTRON CO.
328 LEXINGTON • HOMER CITY, PA.

EASIER • FASTER • CHEAPER

Manufacturers of
STEAM TURBINES • HELICAL & WORM GEAR PUMPS
Centrifugal, Propeller, Clogless, Mixed Flow
Pump Priming Systems
CENTRIFUGAL BLOWERS AND COMPRESSORS
IMO OIL PUMPS
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STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

LEWIS & McDOWELL Inc.
Engineers & Contractors
GUNITE work in all its Branches
Prestressed Gunite Tanks
Waterproofing, all types
Restoration of Masonry Buildings
Synthetic Rubber and other special Tank Lining
Dam Repairs and Reconstruction
285 Madison Avenue, New York, N. Y.
Murray Hill 3-0554

Steel and Dave Cowdin, directors.

Frank E. Southard, chairman of the Maine Public Utilities Commission, has been elected vice-chairman of the New England Interstate Flood Control Committee.

Walter M. Erickson has been elected president of the Milwaukee Builders Exchange. Peter J. Soulen is first vice-president.

Boyd V. Wright, former resident engineer of the Ohio Highway Department at Logan, has been elected president of the Hocking Valley Chapter of the Ohio Society of Professional Engineers.

Louis A. Peacock has been elected president of the Portland, Ore., Chapter of The Associated General Contractors. Other officers elected include: Donald Hall, first vice-president; Marshall Newport, second vice-president, and Jack McDougall, secretary-treasurer.

D. B. Packard has been elected president of the Wilmington, N. C., Engineers Club. Other officers: Cecil L. Mathes, vice-president; H. E. Hicks, re-elected secretary-treasurer, G. G. Thomas and C. H. McAllister, directors.

Elmer L. Hughes was installed recently as president of the Engineers Club of Kansas City. Other officers: C. G. Roush, vice-president and Bert F. Steves, secretary-treasurer.

Thor M. Peterson has been re-elected president of the Port Alberni branch of the British Columbia Contractors' Association.

The Phoenix Chapter, American Association of Engineers, has elected Karl Harris president to succeed C. C. Tillotson. Other officers: Charles S. Beck and A. Glen Smoot, vice-presidents; J. Lee Chambers, secretary-treasurer.

The Engineers Club of Seattle, Wash., has installed Frank W. Knowles as president, with Fairman B. Lee as vice-president. Other officers are: Evans K. Blackford, secretary, and E. D. Alexander, treasurer.

E. Homer Bricker, Medina County, Ohio, engineer, has been elected president of the Ohio Association of County Engineers, succeeding Allan C. Slade of Columbus.

Lawrence B. Gibbs has been elected president of the Southern California Home Builders and Subdividers, a chapter of the National Association of Home

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Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program. CBS network, Sunday afternoon, 3:00 to 4:30 E.S.T.

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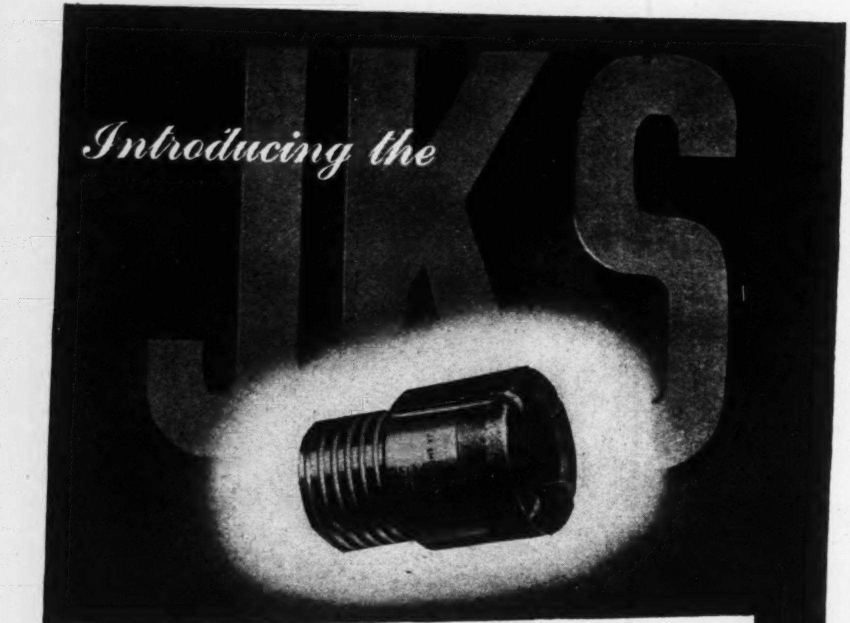

Diamond Impregnated

FERRET BIT

The new JKS Ferret bit gives every promise of being as important a development in the advancement of diamond drilling as the introduction of Finehards by J. K. Smit & Sons, Inc. in 1928.

The Ferret bit offers these outstanding advantages:

SELF SHARPENING – Uniformly distributed diamond particles in a layer of sintered metal allows the bit to wear down without building up pressure. Free cutting throughout its entire life, the bit never needs to be sandblasted or otherwise resharpened.

NO RESETTING – The drilling process consumes the impregnated portion of the bit, eliminating resetting. Footage costs can be computed on the job as the bit is removed from service.

WITHSTANDS ABUSE – The well protected diamond particles are less affected by abuse than whole stones. The Ferret bit is thus adapted particularly to use in weathered, broken or extremely abrasive ground and can take a lot of abuse when starting holes and grinding cores.

MAINTAINS GAUGE – Solid gauge stones set at 1/8" intervals at the base of the impregnated section of the bit, maintain inside and outside gauge for the entire life of the Ferret bit.

FREE CUTTING – As the Ferret bit does not build up pressure as it wears, it will maintain its original rate of feed in the same rock during its full life of service.

LOW COST – Low initial cost, total consumption of diamond impregnated section and long Ferret bit life result in low footage cost. Use JKS Ferret bits on your next job.

Send for BULLETIN F-46.

J. K. SMIT & SONS, Inc.

157 Chambers St., New York 7, N. Y.
2001-A Law and Finance Bldg., Pittsburgh 19, Pa.

Builders of the United States.

Members of the Kansas Contractors Association recently heard Maj. Gen. Lewis A. Pick, division engineer at Omaha, Neb., discuss the Missouri River basin development plan.

The Ohio Equipment Distributors Association has been organized with an office at Columbus. P. L. Patterson, of Cleveland, is president.

The Oshkosh, Wis., Chapter of the Wisconsin Constructors, Inc., recently elected Arnold E. Anderson president.

Leo Dufresne recently was elected president of the Quebec section of the Association of Polytechnic Engineers.

Carl W. Evans recently was installed as president of the Georgia Society of Professional Engineers.

The Wisconsin County Highway Commissioners' Association recently elected Ray Jensen of Calumet County as president. Other officers: Paul Hartwig, La Crosse, vice-president; John Rusch, Langlade, secretary-treasurer.

The American Institute of Consulting Engineers recently elected Enoch R. Needles as president for 1946. Other officers: George S. Armstrong, vice-president; James Forgie, treasurer; and Philip W. Henry, secretary.

James P. Exum, bridge engineer for the Texas Highway Department, recently was elected president of the Texas Society of Professional Engineers. W. A. Rounds, of Fort Worth, was named first vice-president, and R. S. Guinn, of Austin, secretary-treasurer.

The Oregon Technical Council has elected Carl E. Green, civil engineer of the Portland firm of John W. Cunningham & Associates, as president, with Oren Demuth as vice-president, Mark M. Clayton as secretary-treasurer and K. E. Hamblen, director.

General contractors at Vancouver, Wash., have organized a Contractors Association and elected Cecil J. Hearn, Heinrichs, president. Other officers are: Larry O. Collins, vice-president; Drexel Scott, secretary, and C. S. White, treasurer.

J. L. Hazen of Hazen & Clark, general contractors, is the new president of the Construction Council at Spokane, Wash. Serving with him will be H. A. Smith, vice-president, and Al Funk, treasurer. Paul Heydon was re-appointed director of public relations.

Original Woodcut by Lynd Ward

There's a solid satisfaction in specifying cast iron pipe. You know that your choice coincides with the judgment of leaders of your profession the world over. And when the line is backfilled, you are confident that it will serve throughout a long life at a low annual maintenance cost. This has been true of cast iron pipe for centuries; yet in the forty-odd years since our Company was founded, notable advances in manufacturing methods and controls have been made, resulting in a finer, more uniform pipe, either pit cast or centrifugally cast.

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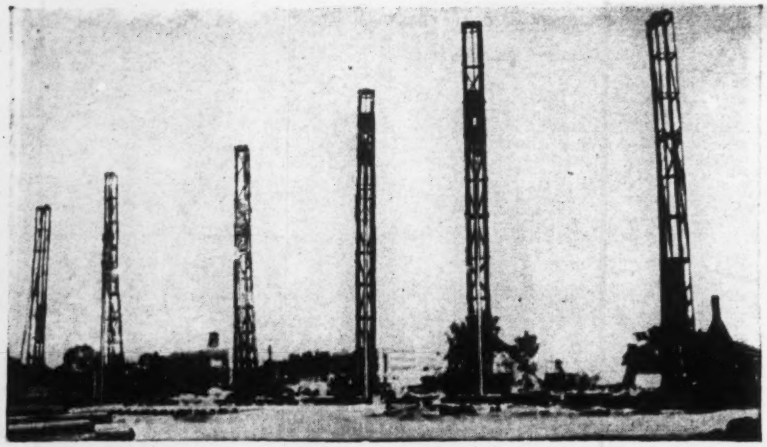
cast iron
PIPE

U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Plants and Sales Offices throughout the U. S. A.



WESTERN

WESTERN FOUNDATION CO. DRILLED-IN CAISSON CORP.
WESTERN CONCRETE PILE CORP.
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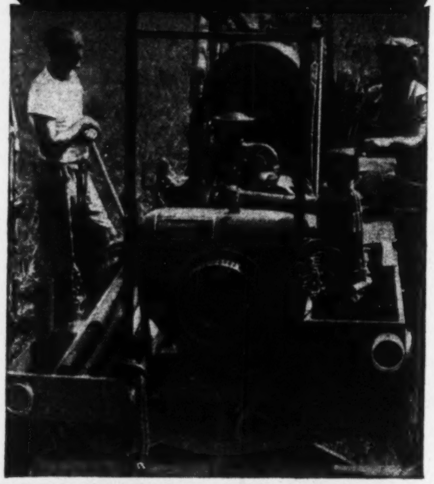
MONADNOCK BLDG., SAN FRANCISCO 5, CALIF.
Write for new catalog



Core Drilling is "Duck Soup" for this WISCONSIN HEAVY-DUTY Air-Cooled ENGINE

The picture shows a Model VE4 Wisconsin V-type, 4-cylinder Air-Cooled Engine powering a Casperson Core Drilling Unit, engaged in oil field exploratory work.

This engine, weighing in at 295 lbs., turns up 22 hp. at 2600 rpm. and is built for rugged, heavy-duty service. It is equipped with Timken tapered roller bearings at both ends of the crankshaft to assure fullest protection against bearing failure under continuous, full-load operation and to take up end-thrust.

Core Drilling is "duck soup" for this engine . . . just one of any number of jobs Wisconsin Air-Cooled Engines are handling in oil field service, with top efficiency, operating economy and heavy-duty dependability.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy Duty Air-Cooled Engines

Men and Jobs

E. L. Gosnell, former chief engineer of the Baltimore and Ohio Railroad, has been appointed chief engineer of the Reading Co., and **Fred. W Biltz**, assistant chief engineer. Mr. Gosnell succeeds **E. Y. Allen** who has retired.

E. L. Gosnell

Mr. Gosnell is a graduate of St. Johns College, Annapolis, Md.. He became associated with the Baltimore and Ohio Railroad in 1906 was sent to Cincinnati, Ohio, in charge of reconstruction of bridges and terminals which had been destroyed by floods. In 1918, he was transferred to the general offices in Baltimore, Md., as assistant to the chief engineer, where he continued as second ranking engineering executive until his present appointment.

E. Y. Allen

F. W. Biltz

Mr. Allen joined the Reading Co. in 1914 as assistant valuation engineer after starting in 1901 with the Long Island Railroad. He was appointed valuation engineer in 1919. In 1934 he was transferred to the engineering department as a special engineer, becoming assistant chief engineer in 1938, and chief engineer in 1943.

Mr. Biltz entered the service of the Reading Co. as a levelman in 1917 and later that year became assistant supervisor. He served in the A.E.F. as an officer in the Railway Transportation Corps., returning to the Reading Co. in 1919.

In 1922, he was promoted to supervisor and in 1934 became assistant division engineer. In 1936 he became assistant to the general superintendent and in 1941 an engineer in Maintenance of Way Department. In 1943, he was again furloughed to enter the armed forces, serving as a colonel in command of the 712th

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When frost heaves the earth, the Mathews protection case grows . . . up it comes in the ground . . . without disturbing the barrel, the member that contains all the working parts . . . and preventing the joint from breaking. As to the barrel: If damaged, it is drawn out and a spare barrel inserted . . . no excavating . . . no breaking of the pavement . . . no waste of time, with the attendant peril to life and property. As to the protection case: It's Sand-Spun (centrifugally cast) . . . purified in the process, freed of strains, strong, elastic.

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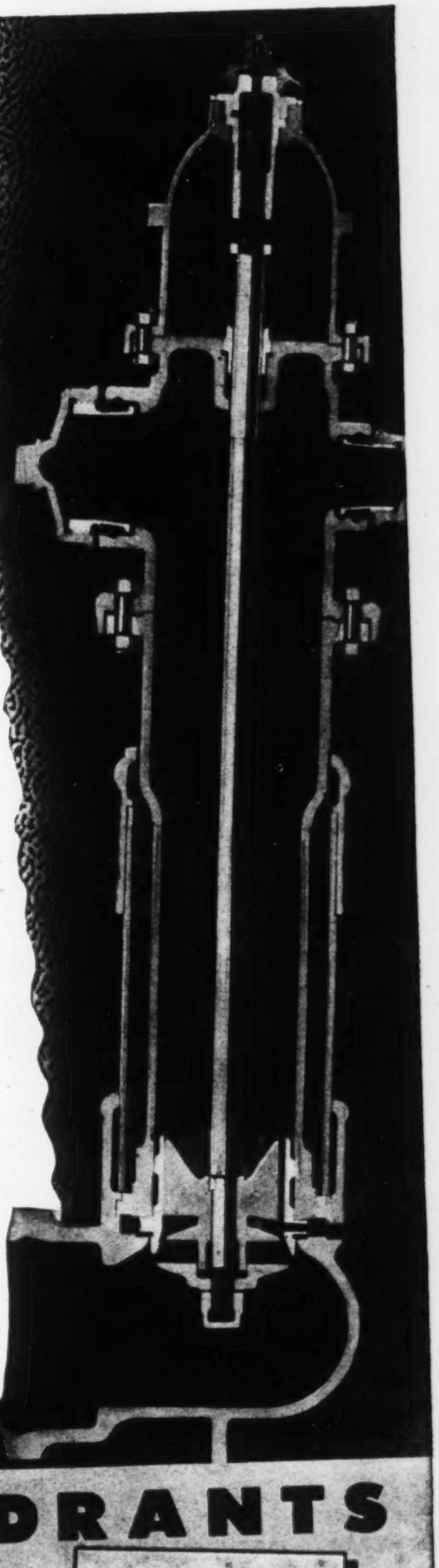

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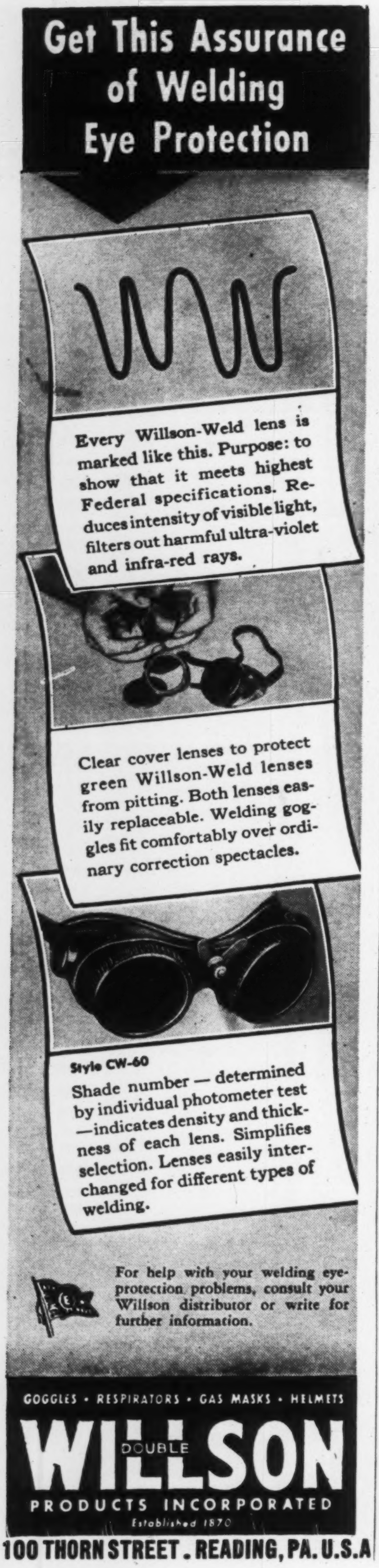

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Railway Battalion, which was sponsored by the Reading Co.

The Austin Co., engineers and builders, have named three new vice-presidents. They are:

Richard Ellis, district manager in the Pacific Northwest. Mr. Ellis, a Harvard graduate, joined the organization in 1924 and served as district engineer from 1931 to 1940 when he was made acting district manager, becoming district manager in January 1945. He was responsible for coordinating the design and construction activities of the Boeing Aircraft Co., Seattle and Renton plants, and the construction of their wind tunnel, as well as in the design and construction of work for the pulp and paper mill industry and other manufacturing fields during the war emergency for civilian industry and the U. S. Army Engineers.

Harold A. Anderson, eastern district manager, joined Austin's New York organization in 1928, following graduation from Tufts College, and after serving as field engineer, designing engineer and estimator, he was named district estimator at Chicago in 1939. He supervised the design and construction of several war projects, including the Chicago Army aircraft plant, and the world's largest bomber turret factory operated by Emerson Electric Manufacturing Co. at St. Louis, Mo. As manager of the eastern district since May, 1944, he has directed Austin's extensive activities on postwar projects for food, pharmaceutical, metalworking, electrical and other industries, as well as its continuing work in the design and construction of synthetic training facilities for the Army and Navy.

Charles W. Payne, Jr., district manager, joined the engineering staff in Philadelphia in 1918, following 8 years with the American Bridge Co. and others in the Chicago area. He has been associated with Austin's Chicago organization since 1919, first in the estimating depart-

Here are 10 basic books of day-in-day-out value in ONE low-priced volume

This book is carefully planned to give the information needed by men who actually plan, select, design, and construct civil engineering structures and projects—in one compact volume and at a reasonable price. The new 1940 edition blends theory, practice and fundamentals equally; and answers your questions in *any* division of civil engineering.

CIVIL ENGINEERING HANDBOOK

Editor-in-chief: L. C. Urquhart, Professor of Structural Engineering, Cornell University. 2nd edition. 877 pp., illus., $5.00.

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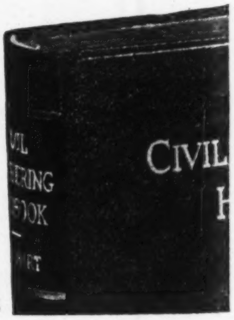
SEE IT 10 DAYS



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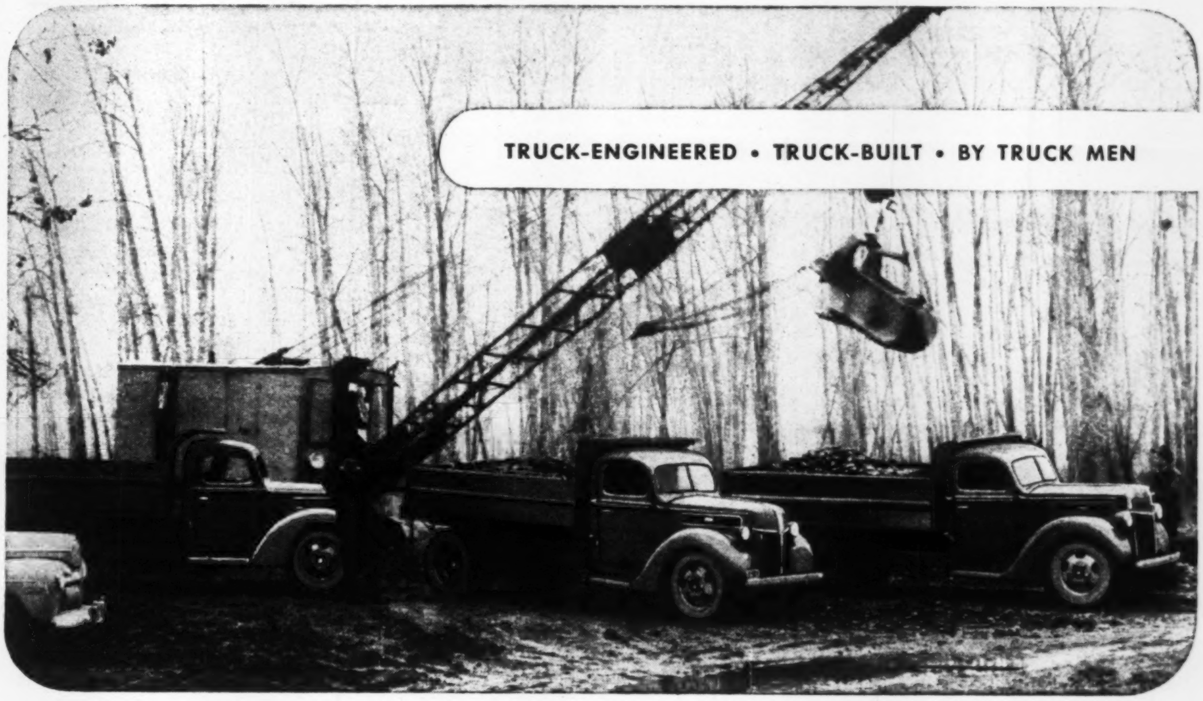

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Only thoroughgoing satisfaction could produce such ever-growing popularity. Contractor G. G. Teskey of Yakima, Washington, wrote some time ago: "*I use two Ford V-8 trucks and one Six, and have had outstanding service from them. They've been very economical and dependable. Service from Ford dealers has been good all through the war emergency. When new Ford Trucks are available I shall be proud to own them.*"

New Ford Trucks are available *now* . . . including a new Dump Truck Chassis, with either V-8 or Six-Cylinder engine.

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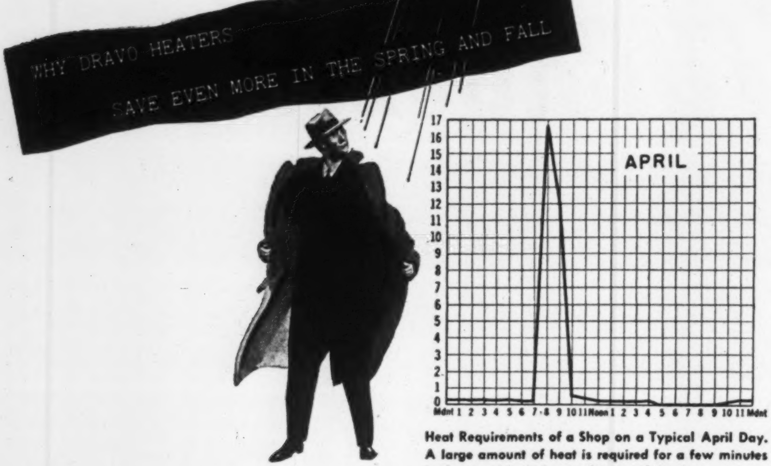
A STILL GREATER 100 HP V-8 ENGINE with NEW Ford steel-cored Silvaloy rod bearings, more enduring than ever in severe service • NEW aluminum alloy cam-ground 4-ring pistons for oil economy • BIGGER, more efficient oil pump and IMPROVED rear bearing oil seal • NEW longer-lived valve springs • NEW improvements in cooling • NEW efficiency in ignition • in carburetion • in lubrication • in ease and economy of servicing operations • And available in all truck chassis except C.O.E. units—the rugged, thrifty 90 HP FORD SIX-CYLINDER ENGINE, with many important advancements.

FORD CHASSIS ADVANTAGES: Easy accessibility for low-cost maintenance • Universal service facilities • Tough, forged front axles • Extra-sturdy rear axles with pinion straddle-mounted on 3 large roller bearings, ¾-floating type in light duty units, full-floating in all others • 3 axle ratios available (2 in 1-ton unit) • 2-speed axle available in heavy duty units at extra cost • Powerful hydraulic brakes, large drums, cast braking surfaces • Rugged 4-speed transmission with NEW internal reverse lock optional at extra cost on light duty units, standard on all others.

FORD TRUCKS

MORE FORD TRUCKS ON THE ROAD • ON MORE JOBS • FOR MORE GOOD REASONS

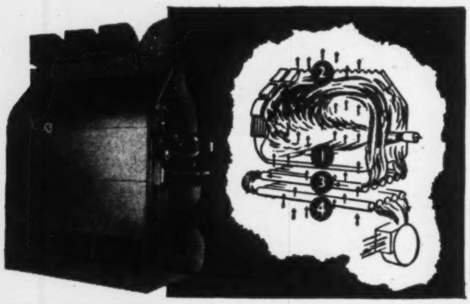


Heat Requirements of a Shop on a Typical April Day. A large amount of heat is required for a few minutes in the morning and none the rest of the day.

Because each heater is a self-contained heat producing unit operating on a direct heat transfer through a single thickness of metal, these heaters can be started up and shut down within a few minutes time. That means there is no standby loss in the Spring and Fall when heat requirements frequently exist for only an hour or so each day. The Dravo heater is so flexible in its operation it can be made to follow the temperature curve without standby loss.

There are many other reasons why these heaters are ideal for large scale space heating. They are shipped complete from the factory with the refractory lining in place, need only to be connected to the fuel line to be ready for operation. They are highly portable and can be moved from plant to plant and spot to spot to meet changing requirements. Efficiencies are high, running 80 to 85%. Maintenance is negligible. No specialized attendance is needed. For the full story of their design and efficiency ask for Bulletin 509-A. Address Dravo Corporation, Heater Department, 300 Penn Avenue, Pittsburgh 22, Pa.

DRAVO
HEATING



DRAVO FOUR PASS combustion chamber design—Flame and gases of combustion flow internally four times across the path of the high velocity air stream being heated. Fins and deflectors on the outside of the chamber materially increase heat transfer. These features contribute to a high efficiency from the fuel consumed—more usable Btu's per barrel of oil or cubic foot of gas.

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Use this Class "E" Clam Shell Bucket for handling crushed stone, gravel, sand and other bulk materials.

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ment, then in sales and service, and since 1942 as district manager responsible for its activities in 16 mid-western states and three Canadian provinces. In this capacity he directed and coordinated the company's mid-western activities which included design and construction of Boeing's B-29 plant at Wichita, ground facilities for two large ore mines in the Lake Superior region and a number of armament plants.

Mr. Payne studied engineering at the Armour Institute.

District offices of the Federal Works Agency's Bureau of Community Facilities are being opened at Boise, Idaho, and Helena, Mont., under the supervision of **L. R. Durkee,** division engineer at Seattle, Wash. **Harry L. Miller** has been appointed district engineer at Boise, and **George F. Burke** at Helena.

James G. Pierson, civil and structural engineer, has opened an office for private practice at Portland, Ore. He has been an engineer for Commercial Iron Works at Portland for the last three years and previously had divided eight years between the Portland district Army Engineers and the Bureau of Reclamation at Vale, Ore.

Col. Frederick J. Clarke has taken charge of the Hanford atomic-bomb materials plant at Hanford, Wash., succeeding **Col. Franklin T. Matthias,** who left the Army to become manager of a hydroelectric project of the Sao Paulo Tramway Light & Power Co., Ltd., in Brazil. Colonel Clarke, an engineer, has been with the Army Service Forces' headquarters staff in Washington, D. C., since 1942.

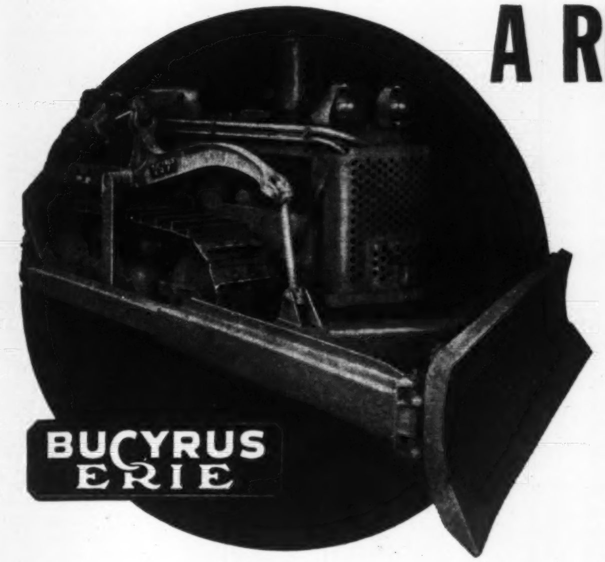
W. R. Wooten, assistant city engineer of Tulsa, Okla., is in his 26th year as a member of the municipal engineering department.

The organization of I. E. Morris & Associates, consulting engineers at Birmingham, Ala., and Atlanta, Ga., has been announced.

Mr. Morris has been a structural engineer for more than 20 years.

H. H. Schdoeder, in charge of the Birmingham office, is a graduate of the Institute of Technology, Bremen, Germany, and has had extensive experience. He is assisted by **Raymond E. Strickland Jr.,** who did post-graduate work at M. I. T. and served during the war with the Corps of Engineers, attaining the rank of major.

In the Atlanta office is **Allen E. Futral,** a veteran of five and one-half years' Army service, who recently was discharged with the rank of colonel. Formerly he was



A REAL DIGGING TOOL THAT'S EASY ON THE TRACTOR

Bucyrus-Erie Bullgrader-International TracTracTor combinations are powerful, economical dirt-moving teams—powerful because the Bullgrader applies the power of this tractor most efficiently; economical because the Bullgrader safeguards the tractor from undue wear and maintenance. Here are the specific reasons why every Bullgrader, designed and built exclusively for International TracTracTors, permits its owner to take full advantage of tractor power; here are reasons, too, why maintenance is so low:

1 ORIGINAL TRACTOR BALANCE IS MAINTAINED

The Bullgrader is mounted to the TracTracTor in such a way that its balance point is not affected. This enables the tractor to do the work for which it is designed, lets it travel both forward and backward without tipping. It means that you get the full tractive effort of the track belt. Track roller loads are distributed evenly. Excessive wear and strain on front track idlers and rollers is eliminated.

2 LOADS ARE APPLIED AT THE PLACES DESIGNED TO TAKE THEM

The main frame of the Bullgrader is attached to the tractor at the point of rotation of the tractor tracks, so that digging thrusts are carried directly to pivots on the rear support brackets. All superstructures are mounted on the track frame, relieving the tractor main frame, engine, transmission case, final drive housing, etc., of damaging stress and shock loads.

Let your International TracTracTor Distributor show you these features. Be sure to ask him about other Bullgrader features, too: hydraulic control that gives you positive digging down pressure, scientifically curved blade, quick angling and tilting, unobstructed vision.

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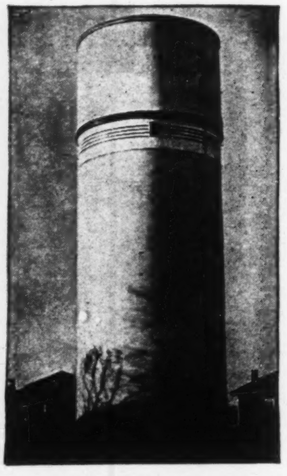
Preload Dome, 155 feet diameter, covering 1,500,000 gallon reservoir

Preload 4,200,000 gallon fuel tanks



Preload 200,000 gallon elevated water tank 38 feet diameter, 126 feet high.

Preload experience gained in hundreds of projects has made it possible to design with proper consideration of earth loads foundations, shrinkage, temperature differences, plastic flow, working stresses, and all other factors which go into this type construction, to your most exacting requirements.

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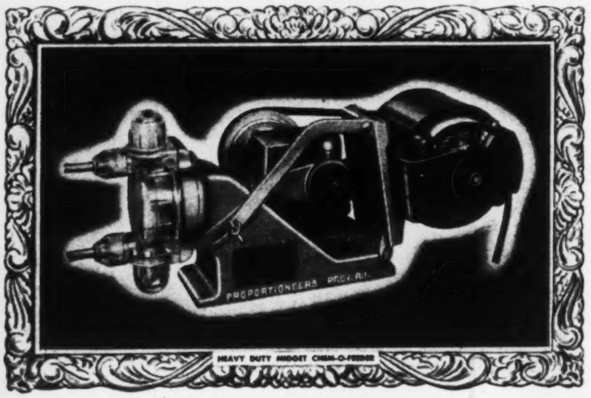

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DESCRIPTION

The Heavy Duty Midget Chem-O-Feeder is a constant rate-of-feed, diaphragm pump equipped with a "See-Thru" plastic reagent head and driven by a 1/6 h.p. 1750 RPM electric motor. The feeding rate is adjustable by means of a duplex eccentric cam regulating the stroke length and by shifting the belt in the three-step cone pulley for adjusting the stroking speed.

SPECIFICATION:

Stroke length: adjustable from .05 to 0.2".
Delivery per stroke 1.5 CC to 10.6 CC.
*Stroking rate: 13, 26 and 48 strokes per minute.
Reagent delivery: Approx. 19.5 to 509 CC per minute — *0 to 8 gallons per hour at atmospheric pressure — *0 to 7.4 gallons per hour at maximum pressure of 85 lbs.

* Based on use of 1750 RPM motor and 50 to 1 speed reducer. Increased capacities can be obtained by using lower ratio speed reducer.

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with the Bureau of Reclamation and the U. S. Engineers.

L. J. Osborn of Lancaster, Kan., has become Doniphan County engineer, succeeding **H. L. Parker,** resigned. Osborn was employed by the Missouri State Highway Department 13 years.

The Osborn Engineering Co., Cleveland, Ohio, has announced the appointment of **F. D. Rideout** as contract manager. Mr. Rideout was formerly assistant engineer and contract manager for The American Bridge Co. in Cleveland, and is well known in construction circles. He is a graduate of Purdue University.

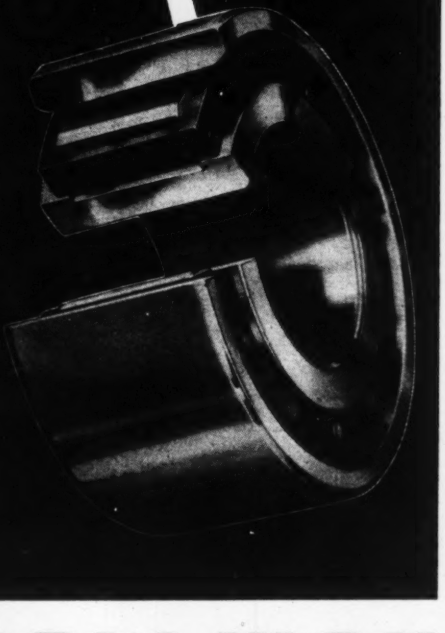
The former chief engineer of the 1st Canadian Army, **Brig. Gen. G. A. Walsh,** has been named commanding officer of the Alaska highway with headquarters at Edmonton, Alta. He is a graduate of Nova Scotia Technical College.

Arthur V. Dienhart, ensign CEC, USNR, formerly in plant construction and maintenance for the Dravo Corp., Pittsburgh, Pa., is now engaged in the construction and maintenance of Navy public works in Saipan.

Flynn E. Hudson, Jr., who since 1941 has been employed on war work in Texas, Tennessee, Alabama, Maryland, Pennsylvania and Ohio, has opened an office at Montgomery, Ala., to engage in architectural work and industrial engineering.

The appointment of **Russell A. Hall** as assistant city engineer of San Diego, Calif., has been announced by **Neal D. Smith,** city engineer. Hall has degrees in engineering from the Universities of Michigan and Illinois, and taught for several years as assistant professor at Illinois and as professor and head of civil engineering at Union College, Schenectady, N. Y. He has had municipal engineering experience with Flint and Detroit, Mich., Toledo, Ohio, and with the Milwaukee, Wis., and Urbana-Champaign, Ill. sanitary districts.

Cut down on MAINTENANCE Shut-downs WITH ROLLWAY RIGHT-ANGLE LOADING



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● Send us a print or detailed description of your bearing needs for free bearing analysis and recommendation. No charge. No obligation. S.A.E., and American Standard metric dimensions and tolerances are available for most applications, assuring quick supply and low replacement costs.

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Manufacturers' Publications

Ditching and Track Maintenance—A new book gives a clear conception of the power of a huge machine and the wide range of its usefulness in railway maintenance. The book has 24 pages, printed in two colors, and is profusely illustrated with action photographs showing the spreading of rip rap and other material, shaping ballast, ditching.—*O. F. Jordan Co., East Chicago, Ind.*

Air Separator—A 4-page bulletin describes a combination air separator and trap for users of compressed air tools and operations. It discusses the need for clean dry air for the protection of pneumatic equipment.—*The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.*

Waterproofing—A circular describes an improved odorless metallic waterproofing which hardens and oxidizes in a few hours. It is used for waterproofing foundations, floors, walls, footings, etc. —*Perma-Bond Co., 1060 Broad St., Newark 2, N. J.*

Crawlers—A folder tells of traction wheels and crawler tracks interchangeable with standard wheels and tires which can be put on, with no changes in axles, for road machinery, snow plows, tractors, cranes, shovels, scrapers and loaders.—*Henneuse Engineering Co., Marion, Ohio.*

Batching Plant Control—A booklet outlines methods and equipment for batching control. It discusses scale accuracy, water control, the value of records, and how to effect savings.—*Scientific Concrete Service Corp., 724 Salem Ave., Elizabeth 3, N. J.*

Acid and Alkali proof Cement—Described in a brochure is a chemically-setting uniform silicate cement which is said to be unusually tough and acid proof, with wide applications for jointing brick or tile in floors, drains, sewers, tanks, towers, tunnels, chimneys, etc.—*Nukem Products Corp., Buffalo 20, N. Y.*

Extra Large Tractors—A broadside describes a big new "Tractractor" that is said to be a giant of power and pull. It is powered by a 6-cylinder full-diesel engine. It apparently is an outstanding prime mover for heavy earth-moving and construction jobs.—*International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill.*